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Estech General Chemicals Corporation Duette Mine, Manatee County, Florida Resource Document: Alternatives Evaluation

Zellars-Williams, Inc., Lakeland, FL

Prepared for

Environmental Protection Agency, Atlanta, GA. Region IV

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The Draft Environmental Impact Statement for the Estech General Chemicals (formerly Swift Agricultural Chemical) Duette Mine is enclosed for your review and comment. The document has been prepared pursuant to Section 102(2)(C) of the National Environmental Policy Act (NEPA) (Public Law 91-190) and applicable EPA regulations at 40 CFR Part 6.9. Thirteen volumes of resource document were also prepared. These resource documents comprise the detailed technical evaluations of the alternatives and the proposed action and contain supporting data related to the Draft EIS. While the Draft EIS is a complete document.

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Environmental Impact Statement

DRAFT

Estech General Chemicals Corporation
Duette Mine
Manatee County, Florida

ALTERNATIVES EVALUATION

RESOURCE DOCUMENT

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ALTERNATIVES EVALUATION

RESOURCE DOCUMENT

Draft Environmental Impact Statement

Swift Agricultural Chemicals Corporation
Duette Mine Site
Manatee County, Florida

October, 1979

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ALTERNATIVES EVALUATION
RESOURCE DOCUMENT

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NOTE:

Effective August 1, 1979, Swift Agricultural Chemicals Corporation changed its name to Estech General Chemicals Corporation.

The preparation of the Draft Environmental Impact Statement was substantially completed at the time of the name change. Therefore, the name of Swift Agricultural Chemicals Corporation (Swift) is used throughout the Draft Environmental Impact Statement and all attendant Resource Documents.

ALTERNATIVES EVALUATION

1. INTRODUCTION

The following are alternatives to the proposed activity by the Swift Agricultural Chemicals Corporation (Swift) at the Duette Mine. Swift's objectives and its proposed action to achieve the objective are included for comparison to each alternative. The alternative assessments included herein are those of: location of plant site, annual production rate of phosphate rock, resource recovery, processes for mining and beneficiation, water supply, waste disposal and reclamation techniques within the mining plan, location of discharges into the surface water system, rock drying, transportation modes from the Swift site to a port destination, power sources, and no-action.

2. PLANT SITE ALTERNATIVES

2.1 Background

It is the objective of a beneficiation site to be placed at a location that would 1) minimize loss of phosphate resources beneath the plant site, 2) minimize water movement energy use and costs, 3) minimize ore and waste transportation energy use and cost, 4) minimize extent and cost of road and utility construction from existing corridors to the plant site, and 5) minimize destruction of environmentally sensitive areas.

Several alternative locations are considered including:

East Boundary of Property Near Duette Road (Site 1) - This site would take advantage of the existing improved Duette Road and would minimize entrance road construction costs.

West Boundary of Property Near State Road 39 Right-of-Way Extension (Site 2) - The main reason to evaluate this site would be its nearness to a proposed railroad route, and its nearness to the proposed power line route.

Northern Area of Property Fronting State Road 62 (Site 3) - This site was selected because it fronts on an existing major arterial highway.

Center of Ore Body (Site 4) - This location was evaluated because building the plant at the centroid of the ore body would minimize energy cost to transport ore and waste products.

Well Field as Designated by the Southwest Florida Water Management District (Site 5) - Building the plant at the well field would minimize water pumping costs from the groundwater field and from

the surface water reservoir.

Proposed Site as Located by Swift (Site 6) - This site was selected by Swift because it would afford good drainage, it is near the center of the ore body, and it is located for the most part in an unmineable area.

The proposed and alternative sites are shown on Figure 2-1.

2.2 Site Assessments

East Boundary of Property (Site 1)

Loss of Phosphate Resource: Covering mineable areas with structures would result in some loss of resource on the 175 acre plant site. Presuming the 80-acre and 40-acre blocks designated unmineable in Section 4, Township 34S, Range 22E, could be used, this would leave about 55 acres of mineable area covered by the plant. At an average 9,300 tons of recoverable product per acre for the entire site, 55 unmined acres would yield a loss of 511,500 tons of phosphate rock. It is presumed that the area selected by Swift for clay settling could be utilized.

Water Pumping: The distance from the surface water reservoir to the case proposed by Swift (alternative 6), and from the reservoir to this alternative, is approximately the same. About 6,700 GPM of deepwell water would be pumped an additional 3,500 feet at a cost of about $0.006 per ton of phosphate rock, 90 percent of which is power.

Ore and Waste Transportation: It would cost approximately $0.50 per ton of product to pump ore to the plant and waste away from the plant the additional mile required by the Duette Site over the case proposed by Swift (alternative 6). About 61 percent of this additional cost would be for power.

Roads and Utilities: Access to Duette Road would require one mile less of road construction; an additional mile of power line, considering access from the western boundary of the property; and one additional mile track extension from the case proposed by Swift.

Environment: Site 1 would be constructed on an area that is partially designated as unmineable (120 acres). This area of cut-over flatwoods with freshwater marshes would otherwise be maintained with the flatwoods enhanced by tree plantings. Site 1 would, however, open up the approximately 175 acre similarly vegetated Swift proposed site (alternative 6) for enhancement and exclusion from mining. Alternative Site 1 does not contain any significant wetland or otherwise unique vegetation. No endangered species were identified as dependant upon the Site 1 location.

Other environmental considerations (e.g., air, water, noise impacts) would not differ significantly from those exhibited at the proposed Swift site. Water withdrawal and discharge points

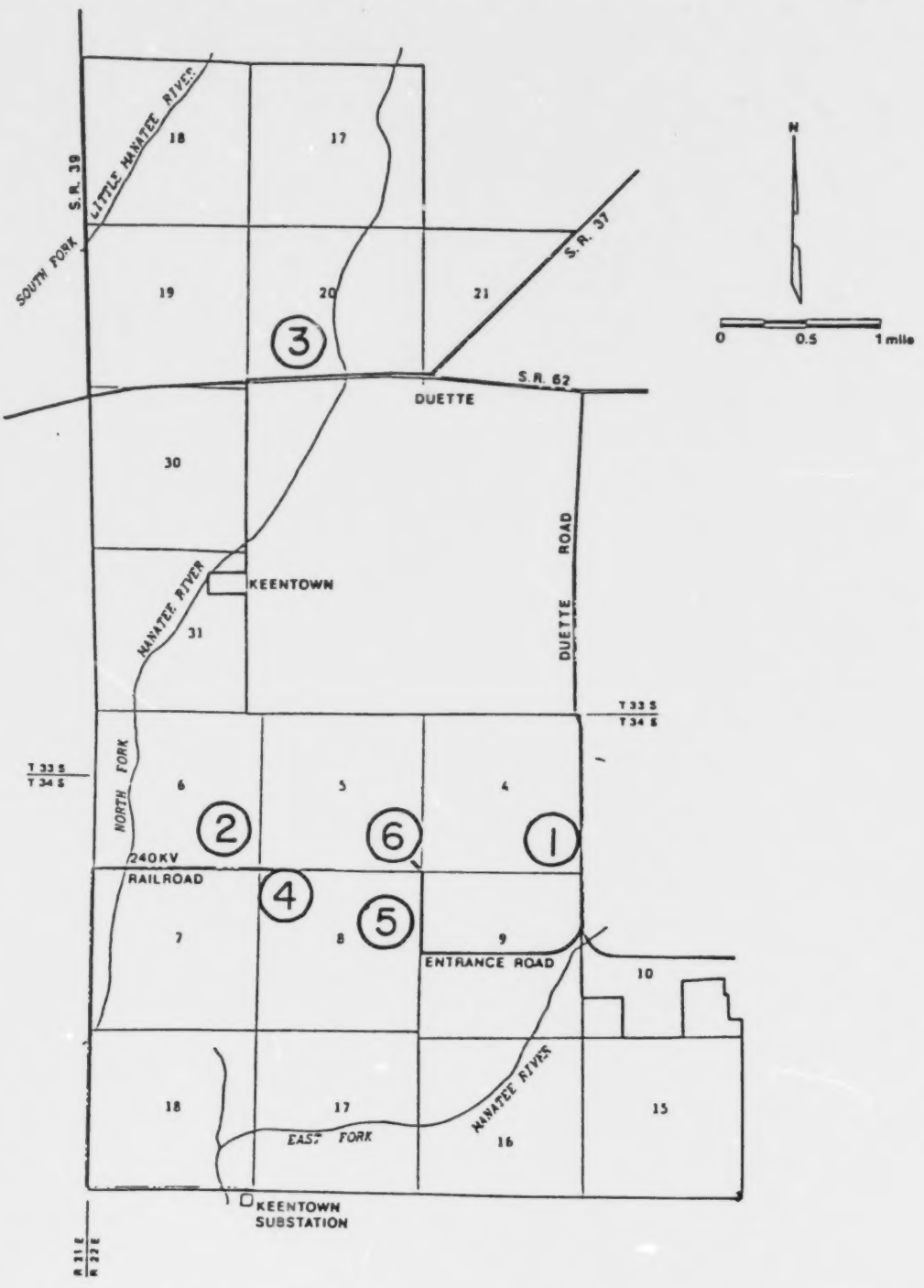


Figure 2-1

Alternative Plant Site Locations

Zellars-Williams, Inc.

would remain unchanged as would the discharge characteristics. Air emission types and rates would be the same although concentrations at the eastern property bounds might be somewhat higher depending on dryer location and control equipment design. No significant noise receptors are located near the eastern property boundary.

West Boundary of Property (Site 2)

Loss of Phosphate Resource: It is presumed that the plant site represents an unmineable area since it was selected by Swift for a settling pond site. There is no resource loss per se. The settling pond layout is reduced by the location of the site in this area, and therefore may have to be extended over mineable areas, assuming the settling pond must remain the same size.

Water Pumping: The plant site is approximately 5,000 feet farther from the surface water pumping station planned in Section 9, Township 34, Range 22, than the case proposed by Swift (alternative 6). The cost of pumping 2,000 GPM of surface water the additional distance and pumping 2,000 feet farther from the permitted well field, will create a total additional cost of water pumping of $0.007/ton, 90 percent of which is power.

Ore and Waste Transportation: This alternative is approximately 1,500 feet closer to the presumed center of the ore body. This would produce a savings in material transportation of about $0.14 per ton of product over the life of the mine. About 61 percent of the savings would be in power.

Roads and Utilities: An additional 3,000 feet of entrance roads would be required, presuming the entrance from Duette Road is maintained. Three thousand feet less of power line would be required presuming an entrance from the western boundary. The total of these savings is about $80,000 over the case proposed by Swift (alternative 6).

Environment: Site 2 would be constructed in an unmineable area that is largely improved pasture with some xeric oak.

Location of the plant site with all the attendant activities approximately 1/4 mile from the preserved wooded floodplain of the North Fork Manatee River may diminish somewhat the capability of the floodplain area to serve as a wildlife corridor during the mine life. It is presumed that relocation of the settling area would be to a designated mineable area. The mineable area would be altered by mining in any case.

The location closer to the river would also increase the potential for minor spills at the plant (fuels, waste products, etc.) to reach the aquatic habitat of the river system. Other environmental considerations (e.g., air, water, noise impacts) would not differ significantly from those exhibited at the proposed Swift site.

Northern Area of Property (Site 3)

Loss of Phosphate Resource: This site covers approximately 200 acres and lies west of the 100-year flood plain of the North Fork Manatee River. This size is adequate for the plant but would require relocating the 480-acre clay settling area away from the plant to minimize resource loss. If the unmineable area in the south one-half of Section 19 were used as a portion of clay settling area, about 250 additional acres containing mineable resources would be needed, resulting in about 2,325,000 tons of lost resource.

Water Pumping: The well field likely would be relocated to reduce pumping of water over land. An alternative surface water source from the North Fork Manatee River would be required.

Ore and Waste Transportation: This alternative is 21,000 feet farther from the center of the ore body than the case proposed by Swift (alternative 6). This extra distance would create about $1.99 per ton of product in additional ore transportation and waste disposal cost. Energy is again estimated to be about 61 percent of this cost.

Roads and Utilities: With access to State Road 62, an entrance road to the plant would not be needed. The cost of utilities to the site would be more because of the longer distance. Presuming the railroad would be solely for Swift's benefit (i.e., Beker's service would not be from the same line) the savings of railroad construction from a northern access would be significant. The total road and utility cost for this location would be about $900,000 less than the case proposed by Swift.

Environment: Improved pasture overlying mineable reserves is found at this location. However, location of a 480 acre settling area as mentioned above would probably destroy the cypress dome located in Section 19. This cypress dome is considered an environmentally sensitive area and is preserved in the Swift proposal. The Site 3 location would also be immediately adjacent to the maintained North Fork Manatee River and would probably diminish wildlife use in the area and increase minor spill potential as described for Site 2. Construction of a surface water reservoir to scalp a sufficient surface water supply for the plant from the North Fork Manatee River at this location would probably require a significant proportion of the river flow. This would adversely affect the downstream aquatic communities.

Location of the plant site at this northern location would bring it in close proximity to the Duette School and Dry Prairie Church located near S.R. 62. Noise impact on the school and church would be greater than from the proposed Swift site and would probably be unacceptable. Location of the settling area in Section 19 would probably require a discharge point into the Little Manatee River and the North Fork Manatee River. Discharge water quality is assumed to be within standards and acceptable.

Center of Ore Body (Site 4)

Loss of Phosphate Resource: This site is presumed to be the centroid of the ore body. Further prospecting by Swift will refine its location. It is located in an area deemed as mineable by Swift and therefore would represent a 175-acre reduction in mineable land. About 1,600,000 tons of resources would be lost. The same settling area as that established by Swift would be used.

Water Pumping: The center of the ore body site is approximately the same distance from the well field, approximately 4,000 feet further from the surface water pumping station, than compared to the Swift case. This would represent an increase in pumping costs at the 2,000 GPM rate of $0.0015 per ton of product, 91 percent of which is power.

Ore and Waste Transportation: The 5,000 foot reduction in ore and waste transportation at this site over the case proposed by Swift would result in a savings of approximately $0.47 per ton of product, of which 61 percent is energy.

Roads and Utilities: With changes in layout the cost of railroad, access road, and utilities would be similar to the case proposed by Swift.

Environment: The pine flatwoods and small freshwater swamp that presently occupy the site would be destroyed either by mining or by selection of the area for a plant. All other environmental concerns (air, water, noise) would be essentially the same as the Swift proposal as Site 4 lies in similar terrain and is in close proximity to the proposed site.

Selected Well Field (Site 5)

Loss of Phosphate Resource: Establishing the plant site at the well field would cause a loss of 175 acres of mineable land and 1,600,000 tons of resource, presuming the designated settling areas could remain in service.

Water Pumping: Locating the plant site at the selected well field reduces the pumping distance from the surface water reservoir by approximately 2,000 feet compared to the proposed Swift site. The combined effects represent a savings of about $0.006 per ton of product in water pumping costs.

Ore and Waste Transportation: This site is approximately 2,000 feet closer to the center of the ore body. This would result in a savings in ore and waste transportation costs of about $0.19 per ton of product over the life of the mine.

Roads and Utilities: Railroad and entrance road costs are essentially the same, and the power line would cost $22,500 less than for the case proposed by Swift.

Environment: This site lies in similar terrain and is in close

proximity to the proposed Swift site. All environmental considerations would be essentially the same.

Proposed Swift Site (Site 6)

The cost of entrance roads, utilities, railroad, ore and waste transportation, etc., for the comparison has been set at base or zero. It is presumed that no mineable zones occur beneath the settling or plant site areas, and there would be no loss of resource. Environmental impacts are treated in detail in the appropriate section of the EIS.

2.3 Selection of Optimum Alternative

The lowest net energy costs would result from locating the plant site at the center of the ore body (Site 4) as shown in Table 2-A. A comparison of the cases shows the cost of material transportation to be perhaps the most significant consideration. Energy consumption represents about 60 percent of this cost. In comparison, water pumping costs are small. Off-setting the savings in Sites 4 and 5 is the resource loss. Locating the plant site nearer to existing access roads would reduce development costs, but would result in higher material transportation costs.

Sites 4 and 5 have essentially the same environmental ramifications as the proposed Swift location. Site 3 exhibits the greatest potential for disturbance of wooded floodplains preserved as a wildlife corridor and for damaging aquatic habitat due to minor spills and surface water withdrawal. This site also necessitates destruction of the environmentally sensitive, 18 acre cypress dome. It also probably results in unacceptable noise levels at sensitive receptor sites. Site 2 exhibits some potential for wooded floodplain disturbance but does not otherwise differ significantly from the Swift proposal. The primary constraint on Site 1 is the potential for unacceptable air pollutant levels at the property boundary.

From the energy and cost point of view, the two most feasible alternatives are the Swift proposal (Site 6), which would minimize ore transportation costs, and the western boundary location (Site 2), which would have smaller material transportation and development costs than Site 6. Site 2 does, however, exhibit a somewhat greater potential for damage to an environmentally sensitive area (floodplains) than Site 6.

3. PRODUCTION RATE ALTERNATIVES

3.1 Background

It is the objective of a production rate to produce rock at a rate that will make the corresponding cost of production competitive in the world market; to insure a reasonable profit; to maintain a production rate that will respond to overall rock demand growth; to replace present production as existing Swift facilities mine

Table 2-A Economic Comparison of Site Alternatives

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Reserve Loss (Short Ton Product $000's)	511.5	0	2,325	1,600	1,600	0
Cost Water Pump ($/ton Product)	+.006	+.007	0	+.0015	-.006	0
A. Energy Cost	+.005	+.006	0	+.0012	-.005	0
Matrix and Waste Pumpage ($/ton Product)	+.50	-.14	+1.99	-.47	-.19	0
A. Energy Cost	+.45	-.12	+1.80	-.39	-.17	0
Total Energy Cost ($/ton Product)	+.461	-.107	+1.80	-.383	-.181	---
Access Road, Railroad, Utility Cost ($000's)	+ 250	- 80	+ 900	0	- 22	0

out; and to meet environmental permitting requirements.

There are certain inherent fixed costs in rock production. Consequently, as the rate of production increases, the cost of production decreases. Time is needed, however, to pay back the capital investment of a mining facility and this factor must also be considered when establishing the optimum production rate. Extremes in either production rate or time are uneconomic. Increments of production are based on the number of draglines employed. For example, one optimum size dragline will produce approximately 1.5 million tons per year; two draglines, 3 million TPY, etc. There are physical limitations on the application of larger draglines. In addition to the 3 million TPY production rate proposed by Swift, the alternatives of 1.5 million TPY and 4.5 million TPY are assessed.

3.2 Production Rate Assessments

Production Cost - The first alternative represents the minimum design capacity for the optimum dragline and ore transportation system which is heavily dependent upon the ore body characteristics. Given a certain size deposit, however, with the mill facilities located at the epi-center, capital expenditures for entrance roads, railroad branch lines and support facilities are not directly related to production capacity. Interest and depreciation expenses on invested capital are major contributing factors to production costs. Consequently, this alternative does not represent the maximum utilization of the plant infrastructure investment and the operating cost is the highest of the three alternatives. Alternative two and three are preferred since they are less costly and represent an increased production level with similar fixed costs of alternative one.

Demand and Growth - A fundamental requirement of the production rate selected is that it maintain Swift's present percentage of sales. Within this framework it must respond to demand and growth and replace present production as existing facilities mine out. Table 3-A shows a comparison of the total production of Swift's mines at the end of the next decade when supplemented by each of the three alternatives and the cumulative total production increase each alternative entails. Recent studies (Zellars-Williams, Inc., 1978) show a 2.5 percent compounded production growth rate for the phosphate industry over the past decade and a 6.1 percent rate since 1955.

Alternative one, at 1.5 million TPY, shows no growth increase and is a 10.7 percent reduction from present production.

Alternative two, at 3.0 million TPY, is reasonable in that it replaces mined out production and provides for demand growth at a rate consistent with historical demand growth of the phosphate industry.

Alternative three, at 4.5 million TPY, is excessive in that it is decidedly more than necessary to replace existing capacity and

is in excess of historical growth rates. Swift would have to increase its sales capability in order to produce at this rate and make a reasonable profit.

Table 3-A Swift Phosphate Rock Production

	1978** Production MTY	1988** Production MTY	Cumulative Production Change,%
Alternate One			
Silver City	1.9	0*	
Watson	0.9	1.0	
Duette	0	1.5	
	2.8	2.5	-10.7
Alternate Two			
Silver City	1.9	0*	
Watson	0.9	1.0	
Duette	0	3.0	
	2.8	4.0	+3.6
Alternate Three			
Silver City	1.9	0*	
Watson	0.9	1.0	
Duette	0	4.5	
	2.8	5.5	+7.0

**Area Wide EIS Central Florida Phosphate Industry, U.S.E.P.A. 1978.

*Mined Out.

Environmental Aspects - The variable production rates, would alter the pace at which native habitat is destroyed by mining but assumably, would not alter the total amount eliminated or the subsequent reclaimed land form. The long-term effect of a net loss of terrestrial wildlife habitat due to replacement by pasture would not differ among the alternatives. Similarly, the long-term net gain in aquatic habitat (lakes, marshes) would not differ.

Groundwater withdrawal rates would increase proportionate to production capacity. At the lowest production rate, deep aquifer drawdown would assumably conform readily to the basic regional water management authority guidelines concerning allowable drawdowns at the property boundary and "water crop" (allowble withdrawal rate based on amount/acre/year). At the 3.0 million

TPY rate (proposed action), certain exceptions to guidelines were requested by Swift and approved by the regional water authority. These exceptions were granted on the finding that the proposed withdrawal rate (with conservation measures), although not in strict conformance with guidelines, did not adversely affect regional water resources. Based on a straight line interpretation, it is assumed the 4.5 million TPY rate would require greater withdrawals than could be supported by the regional water resources or at least not be permitted under current regional authority guidelines.

It is expected that ambient air concentrations of sulfur dioxide would be nearly identical at production rates of 1.5 and 3.0 million TPY as at both rates it would be economically feasible to controal annual sulfur dioxide emissions to conform with a 50 TPY Prevention of Significant Deterioration (PSD) limit which qualified the source for exemption from detailed PSD review and Best Available Control Technology (BACT) requirements. However, the total sulfur dioxide contribution would be approximately double for a 1.5 million TPY production rate since the mine life would be proportionately extended. At the 4.5 million TPY production rate, the economic trade-off for emission control below 50 TPY is less attractive and it is likely that the source would opt for full PSD review and application of BACT technology. From a historical perspective, BACT for relatively small sources has been a requirement to burn low sulfur fuel rather than flue gas treatment. Since the proposed source plans to use low sulfur fuel and a flue gas treatment may not be imposed, a greater than proportionate increase in ambient concentrations of sulfur dioxide could accompany a 4.5 million TPY mining rate. It is unlikely that the suspected increase would fail to satisfy NAAQS or PSD regulations, but less air resource would be available for other industrial growth needs within 30-50 kilometers of the proposed source. Thus, from the perspective of sulfur dioxide, the nominal 3.0 million TPY mining rate appears the most optimal choice for air resource conservation.

Ambient air concentrations of particulate matter would vary in an approximate direct proportion with production rate since the emission rates are a function of proportionate increases in air flow through the rock dryers. The applicable regulatory control strategy (BACT) is based on the air flow. Ambient particulate matter standards and PSD increments would undoubtedly be satisfied at either of the three production rates, but as rate is increased, less air resource would be available for other industrial development in the region referenced above.

Other mining related pollutants, e.g., nitrogen oxides, carbon monoxide, etc., would also be expected to vary in proportion to the production activity level and while not exceeding the NAAQS at any of the three alternative production rates, each increase would leave less available margin with respect to the ambient air quality standards.

3.3 Selection of Optimum Alternative

Table 3-B summarizes the typical dragline requirements, capital costs, and production costs for the three production rate alternatives.

To meet Swift's overall objective, mining at a rate that will make the production costs competitive and will maintain their share of the market, it appears their production rate has been reasonably selected.

Alternative two and three represent distinctly different production costs based on the Bureau of Mines report, rather than Swift's actual production cost. In terms of meeting anticipated overall growth and demand and meeting replacement requirements for production, it appears that alternative two meets the closest percentage of projected growth and replacement of production.

Consideration of environmental aspects indicate all alternatives would have essentially the same long-term effects on vegetation and wildlife. Positive aspects of alternative one is that groundwater withdrawal would cause the least stress on regional water resources and particulate emissions would be lowest. Annual SO_2 emissions would be largely the same for alternatives one and two but the long-term contributions of one would be twice that of alternative two. Alternative three has a considerable potential to exceed groundwater withdrawal limitations and exhibits the highest air pollutant contributions.

Table 3-B Production Rate Alternatives

Production TPY	---Draglines--- No.	Yards	M $	*Capital Cost Mine and Mill M $	*Production Cost Mine and Mill M $
1,500,000	1	50	13.0	53.55	20.875
3,000,000	2	50	26.0	90.00	18.284
4,500,000	3	50	39.0	119.54	18.000

*"Evaluation of the Phosphate Deposits of Florida Using the Minerals Availability System." Bureau of Mines. Open File Report No. 112-78. Zellars-Williams, Inc. June, 1978.

4. RESOURCE RECOVERY ALTERNATIVES

4.1 Background

It is the objective to maximize recovery of the non-renewable mineral resources at an acceptable cost with primary consideration given to impact on renewable natural resources, principally wetlands.

Two alternative cases for resource recovery are assessed in comparison to the proposed action (Swift's proposal).

4.2 Resource Recovery Assessment

Case 1 - The Proposed Action - This case represents the proposed mining and reclamation plan of Swift. Resource recovery of the plan would be about 61.5 million product tons of phosphate rock recovered over a 20-21 year mining period.

In achievement of the proposed recovery, Swift has excluded the lower quality "unmineable" ore and ore of varying quality underlying much of the forested swamp community found along major water courses and the cypress dome. These exclusions represent about 761 acres of forested swamp. Proposed mining of forested swamp includes approximately 350 acres consisting of several small, ephemeral feeder creeks and headwater depressions, 71 acres consisting of a single feeder creek located in the south-central portion of tract, and 55 acres along an approximate one mile segment of a major water course, the East Fork Manatee River. The Swift plan encompasses mining of approximately 364 of the 600 acres of freshwater marsh found on-site. The marshes occur as small, temporary ponds with emergent vegetation and are largely scattered throughout the upland areas of the site. It is presumed all marshes overlying recoverable reserves are proposed for mining except those found within the floodplains of the major water courses.

The Swift plan proposes to mitigate the loss of 476 acres of forested swamp and 364 acres of marsh by implementing reclamation techniques intended to restore similar wetlands habitat. Accomplishment of the proposed wetlands restoration effort would result in a long-term net increase of wetlands on-site through reclamation of about 485 acres to forested wetlands and 628 acres of marshland.

Case 2 - Forested Swamp Exclusion - This case excludes the mining of all freshwater swamp found on the mine site but does not exclude mining of marshes. Resource recovery of this case would be about 57.65 million product tons of phosphate recovered over a 19-20 year mining period. A presumption in this case is that, with the exception of a higher depreciation rate to account for the resource loss, higher extraction costs would not result.

The Case 1 proposed action of mining 476 acres of swamp would be eliminated incurring a reduction of about 3.85 million tons or more than one year of production. The total exclusion of mining forested swamps results in the maintenance of 1,219 acres of freshwater swamp and 18 acres of cypress swamp on the mine site.

This case assumes a mitigating effort of marsh restoration as proposed in Case 1. This case eliminates the need for any mitigative actions concerning forested swamps.

Case 3 - All Mineable Areas Owned by Swift - This case includes recovery of all phosphate rock resources regardless of vegetative cover or current land use. Resource recovery would be about 65.9 million product tons of phosphate recovered over a 21 1/2 - 22 1/2 year mining period.

The case includes mining of approximately 950 acres of forested swamps including most of the swamp along major drainage courses and the cypress swamp. Only about 287 acres of forested swamps would remain on-site. The inclusion of the additional areas over that proposed in Case 1 would result in an additional 4.4 million tons of rock recovered over that shown for Case 1 and 8.25 million tons recovered above Case 2.

This case assumes the same marsh mitigating effort as for the previous cases. If acre for acre wetland restoration is assumed, implementation of this resource recovery alternative would necessitate accomplishment of an almost total reconstruction of major and minor drainage courses with wooded floodplains and the re-establishment of a cypress dome.

4.3 Selection of Optimum Alternative

Table 4-A shows the tradeoff relationship between resource recovery cost and regulatory constraints.

Table 4-A Resource Recovery Alternatives and Regulatory Constraints

Change in Resource Recovery	Change in Cost	Meets Regulatory Constraints
Case 1 - Proposed Action	-0-	Permit required for East Fork Manatee River System
Case 2 - Loss of of 3,850,000 tons	Would create slightly higher depreciation rate to account for the resource loss.	Would meet maximum constraints regarding wetland protection
Case 3 - Add 4,400,000 tons rock	Any mitigative action would add to costs.	Would require approval of DER and Corps of Engineers

Case 1, as proposed by Swift, is presented as nil cost. Case 2 has a nil cost effect but would lead to a loss of 3.85 million tons of phosphate resources. Case 3 increases resource recovery, but has the significant cost effect of adding extensive mitigative action.

With regard to the tradeoff relationship between resource recovery and potential adverse impacts on marsh-type systems, it appears negative effects would, at worst, be of low magnitude and

significance considering both biologic and hydrologic functions. For all cases, freshwater marsh re-establishment is expected to be a relatively rapid process even when un-assisted. Although the potential exists for development of pure stands of cattails in the constructed depression and lake littoral zones, this occurrence would not be expected to significantly affect the hydrologic function of the re-established marshes. The cattail marshes would also be expected to support many of the animals inhabiting pre-mining marshes of the site.

Concerning the balance between resource recovery tradeoffs and potential impacts related to mining of freshwater swamps, each alternative offers distinctly different implications. Case 2 represents the "least risk" alternative as all wooded wetlands, regardless of importance, would be maintained intact at the incurred, irretrievable loss of several million tons of phosphate rock product over the other alternatives. Case 3, on the other extreme, offers maximum resource recovery but with the potential of incurring highly significant, high magnitude adverse effects on all important biologic and hydrologic systems if freshwater swamp regrowth is unsuccessful. Case 1, not necessarily intermediate to the extremes, also offers the possibility of moderately significant, high magnitude adverse effects if freshwater swamp regrowth is unsuccessful in the mined, one-mile segment of the East Fork Manatee River.

Based on the operation cost/resource recovery and potential impact/resource recovery comparisons made, the optimal alternative would appear to be somewhere between Case 1 - Proposed Action and Case 2 - Swamp Exclusion as large scale wooded wetland restoration efforts are unproven. Case 2 includes preservation of some wooded wetlands that are isolated and/or normally intermittent in nature and exhibit insignificant or minor hydrologic and biologic functions. Conversely, Case 1 proposes mining of largely undisturbed wooded floodplains that contribute significantly to the overall hydrologic and biologic functioning of site and general area.

5. MINING METHOD ALTERNATIVES

5.1 Background

Mining method objectives are maximum recovery of the mineral resource at optimum cost with reasonable use of energy, water, and environmental resources. Mining is to be conducted to allow for efficient and useful land reclamation.

Only open pit (strip mining) ore extraction methods are considered feasible since underground mining is not suited for the sandy soils prevalent in Manatee County. Mining methods selected therefore, include:

Large Electric Walking Draglines - This is the proposed method and is the primary technology used in Florida and North Carolina

phosphate mines.

Dredge Operation - Dredges are presently used in North Carolina to partially strip overburden and dredges were used to a limited degree in Florida before the advent of draglines. One proposed new operation intends to use large capacity dredges for stripping and mining.

Bucket Wheel Excavators - These large capacity machines have been used at some open pit operations. They are capable of moving large volumes of material at low cost.

Combination of Techniques - Combinations are considered for: 1) dredge stripping of overburden with dragline mining of ore, and 2) bucket wheel stripping with dragline mining of ore. In these cases the overburden would be removed and transported to reclamation areas while the ore would be removed by draglines from the remaining bench atop the ore.

The primary areas of concern include ore recovery rates, cost (including secondary handling of overburden during reclamation), energy use, water use/conservation, safety and environment. The four methods of mining are discussed and evaluated under each of the six areas of concern.

5.2 Method Assessments

Ore Recovery - The phosphate matrix (ore) is generally overlain by a section of sandy overburden which can contain clay. In some cases, the overburden contains a layer of tough hardpan. The overburden matrix contact zone is likely to be uniform in elevation or in composition. This variable condition also occurs with the bottom contact and it is not uncommon for sharp changes to occur over relatively short horizonal distances.

The matrix is usually not tough, consisting primarily of sand, sand sized phosphate, and clay. All the alternative techniques should be capable of removing the material.

Ore recovery is a function of the thickness of the matrix zone, typically yielding high values (90% $\pm$) for thick sections (30 or more feet), moderate recoveries (85% $\pm$) for moderate thick sections (15 feet $\pm$), and lower recoveries for thin ore sections. Recovery losses occur primarily at the contact zones. Recovery is aided by close supervision by pit geologists and their ability to observe the contact zones during the mining process.

Ore recoveries using draglines commonly average 85% $\pm$ and would be acceptable on the Duette site since the matrix zones are relatively thick. Draglines offer the operator visual control and physical access to the digging operation for control of contact zones.

Dredge mining would remove overburden underwater in several "lifts". The overburden would be pumped, probably at least one

mile, to an area being filled for reclamation. Mapping of the upper ore contact zone, without visual control, would be done by closely spaced drilling. The final "sweep", or contact zone cleaning step with the stripping dredge, would require close supervision to prevent either recovery losses due to overstripping or excessive dilution of the matrix with overburden due to understripping. Dilution of the matrix with sandy overburden would result in additional phosphate recovery losses during the beneficiation step.

The mining dredge would remove the total matrix section because poorer intermediate strata could not be rejected. Maintaining an accurate bottom contact would be a problem due to irregular contacts, holes filled with phosphate, lime horses, etc. Inaccurate bottom contact would result in greater pit bottom loss than with a dragline. Although control procedures would probably be more expensive, it is possible that matrix recovery with dredges could be made to approach 85 percent under favorable conditions such as, matrix zones 30 feet or greater in thickness. However, it is speculated that ore recovery would average around 5 percent lower than dragline recovery under similar conditions.

Bucket wheels sit on the bench (or pit bottom) and mine the face of the highwall. The close proximity to the matrix and the requirement for complete pit water control to prevent inundation of the machine would probably result in improved mine recovery. This technique has not been used in phosphate mining, but its ore recovery has been estimated to be better than with a dragline.

Combinations of dredge or bucket wheel stripping with a dragline mining the matrix have not been used in open pit mining in Florida. If the pit were effectively dewatered and the dragline could walk on the bench (top of matrix), this procedure would work. Since most of the overburden would be removed from the mining area, no matrix losses would occur due to overburden encroachment on the matrix and close contact zone control could be achieved. An excellent matrix recovery probably could be attained with these combination methods.

Cost - Comparison of costs is based on estimates of power costs, labor, maintenance, supplies, mine support equipment and depreciation expense on capital cost (15 year straight line). Other cost items such as overhead, taxes, insurance, etc., are assumed to be about equal for all alternatives and are not included. These relative costs are summarized in Table 5-A.

Energy Use - The energy required for the mining alternatives may be derived from the power costs presented in Table 5-A and the power costs for reclamation. In general, the reclamation credit is derived from reduction in final grading and capping of backfilled area by bulldozers. Thus the cost of fuel is about 10 percent of the indicated savings. In equivalent electrical power usage the various cases would be:

Table 5-A Stripping and Mining Costs - $/Ton of Product

Cost/Case	1) Draglines	2) Dredges	3) Wheels	4) Combination
Power	0.35	0.71	0.62	0.65
Labor	0.16	0.19	0.22	0.18
Maint. & Support	0.17	0.21	0.18	0.20
Depreciation	0.62	0.44	1.11	0.53
Credit for Reclamation	0	(0.17)	(0.14)	(0.17)
Totals	1.30	1.38	1.99	1.39

Major assumptions on which Table 2.4-A is based are:

oo In cases 2, 3, and 4, it is assumed that overburden will be transported about one mile.

- oo Draglines -12.6 KWH/ton of Product
- oo Dredges -25.0 KWH/ton of Product
- oo BWE -21.7 KWH/ton of Product
- oo Combination -22.9 KWH/ton of Product

Energy conservation can best be achieved by minimizing the distance the overburden is moved. Thus the dragline is favored.

Water Use and Conservation - The conventional dragline mining operation does not consume water directly. Water is consumed (lost from the system or made unavailable for use) through evaporation, absorption by clays, and physical removal from the site by shipment or runoff. Dredge mining may result in a minor loss of water by formation of colloidal clays when dredging and pumping overburden. From a water conservation standpoint, draglines and bucket wheels are preferred. Open pits (draglines and BWE's) temporarily effect the adjacent water table by pit dewatering. Dredges would have less impact if pools are maintained at a high level.

Safety - "In the pit" operations can be hazardous due to highwall failures. Thus, the bucket wheel technique is considered to be less safe than other methods. Dredge operation requires people to work over water, which can be hazardous. Failure of highwalls is also possible in dragline operations, and it is assumed that by selection of this method Swift has resolved stabilization either by engineering and/or overburden dewatering.

Environment - All open pit extraction alternatives would exhibit largely the same long-term impacts on vegetation and wildlife assuming like areas are mined and are similarly reclaimed. The dredge method would not, however, necessitate dewatering of the mine pit and the attendant lowering of the water table on either side of an active pit. Unmineable tracts with native vegetation located adjacent to mine pits or similarly located preserved floodplain areas would not be subject to stress on the short-term by the temporary soil dissication. The differences in water consumption are not substantial enough to affect significantly the water deficits caused by mining on surrounding lands. Environmental considerations, therefore, are not significant factors in selection of the mining methodology.

5.3 Selection of Optimum Alternative

Table 5-B summarizes the factors evaluated in the mining methodology assessments. Based on the tabular comparison, the dragline would be the preferred although dredging would be acceptable.

Table 5-B Comparison of Mining Alternatives

Item/Case	Dragline	Dredges	Wheels	Combination
Ore Recovery	85-87%	80-82%	88%+	88%+
Cost, $/Ton, Prod.	1.30	1.38	1.99	1.38
Energy Use, KWH/Ton	12.6	25.0	21.7	22.9
Water	B	S	B	S
Environmental	E	E	E	E
Safety	B	S	P	P

Ratings: B-Best, S-Satisfactory, P-Poor, E-Equal

6. ORE TRANSPORTATION ALTERNATIVES

6.1 Background

Transporting the matrix from the mine to the beneficiation plant should be achieved at a minimum cost with optimum use of resources and with minimal effect on the environment.

All methods of transporting the matrix from the mine pit to the beneficiation facility are energy intensive due to the large volumes of material involved. This problem is common to the mining industry.

Transportation of the matrix from the mine to the beneficiation plant would require more than 17 million tons of insitu material to be moved per year. The average transport distance for matrix to the mill is more than two miles. Thus, over a 20-year life, 680 million ton-miles would be required to produce 60 million tons of product (11.3 ton-mile/ton of product). The ore is distributed over most of the 10,394-acre tract. The plant is located near the presumed center of the ore body to minimize transportation. Design and operation of satellite portable plants or "field washer" plants has not been shown to be economical or technically satisfactory, for distances less than six miles, at conventional ore transport costs.

"Bringing the plant to the ore" creates many operational and logistical problems. Temporary facilities are expensive due to the heavy equipment and complex flowsheets involved. Product pebble (+14 mesh particles) are produced early in the beneficiation process and require separate handling. Field washers can remove only part of the clay fraction, about 20 percent by weight of the ore, before transferring the remainder to the main plant location. For these and many other operational reasons, the alternate of localized beneficiation plants was eliminated from further consideration for this ore body. The alternatives with merit are outlined below.

o Conventional Slurry Pumping - The matrix is placed in a slurry pump by the dragline. High pressure water monitors disaggregate the matrix forming a slurry of 25-35 percent solids which is pumped

to the washer through 18-22" diameter pipelines.

o Conveyor Systems - Conveyor systems only transport ore, thereby saving the power used in slurry pumping to move water. Methods of loading the conveyor directly by a dragline have not been developed; therefore, intermediate handling of the ore is necessary, at some additional energy cost.

o Trucks - Trucks have advantages similar to the conveyor, but are labor intensive and require substantial internal road construction and maintenance.

6.2 Major Constraints

The major constraints on ore transportation include technical and operational feasibility, cost, energy use, water use/conservation, and environmental effects.

Technical and Operational Feasibility

Slurry Method: The conventional slurry method is used by all companies operating in the Central Florida field and has proven technical and operational feasibility. Brewster Phosphates uses a hybrid system where the slurry is pumped by conventional means a short distance to a field dewatering/desliming station. The partially deslimed ore is then placed on a conveyor belt and moved to the beneficiation plant.

Conveyor Method: Uniform feeding of the belt is the most difficult problem with conveyor transport of matrix. If there are two separate operating mining locations, as proposed by Swift, about 1,300 tons of matrix per location per operating hour at 20 percent moisture must be fed while the system is running. Draglines are intermittent rate machines averaging about 50 tons per minute when mining matrix. The 50 tons are, however, delivered at one time and cannot be placed directly in a belt feed hopper. Dropping the bucket contents damages receiving equipment. It is necessary to provide an intermediate receiving and belt feeding system. One system would be for the dragline to place the matrix on the ground where it can be continuously recovered by a small bucket wheel excavator feeding the conveyor. For this system to be used in the evaluation, the extra cost of the wheel and ore rehandle must be included. It is necessary to disaggregate the belt-conveyor matrix with high pressure water and hammer mills once it arrives at the washer. This is accomplished at the slurry well by the conventional pumping method.

Truck: Truck transportatin of ore is practical in many mining operations and very large trucks have been developed for this purpose. These off-the-road machines can transport up to 350 tons of material, but they cannot be loaded directly with a 50 cubic yard dragline. Assuming a 55-ton truck at an average speed of 20 mph with optimal load-unloading time, each truck could deliver about 220 tons per hour. At a 55 percent operating factor (accepted availability of 4,800 hours per year), 16 trucks (about

eight per mining location) would be in operation at one time for the average hauling distance. Close planning of short and long mining locations could probably maintain a servicable fleet of 16-18 trucks. The following operational problems must also be considered:

o Secondary handling of matrix would be required (Small bucket wheel or pay loader).

o Extensive truck maintenance facilities would be required.

o The ore would still have to be gunned or disaggregated at the washer.

o Trucks are labor intensive, both for operations and for maintenance.

o Road construction, maintenance, river crossings, highway crossings, poor soil conditions, heavy seasonal rainfall would cause problems for trucks.

o Safety would be a factor.

o Environmental distrubances, such as dust and exhaust fumes, would have to be considered.

It is generally accepted that trucks can be economical for short, routine ore hauls up to a mile. But the problems outlined above make the use of trucks not feasible for the long term operation of the proposed Swift mine.

Cost - Comparison of cost is based on estimates of components on a per ton of product basis. The components considered include: power, labor, maintenance supplies, support equipment, and depreciation.

Other costs such as overhead, taxes, insurance, etc. are equivalent for each alternative and not included in the following table.

Table 6-A Summary of Relative Costs for Ore Transportation Alternatives

Cost/Case	1) Pumping	2) Conveyor*	3) Trucks
Power (Fuel)	0.48	0.31	0.38
Labor	0.20	0.25	0.29
Maintenance, etc.	0.14	0.16	0.45
Depreciation	0.11	0.16	0.21
Total	0.93	0.88	1.33

*Notes: Cable conveyor used. Conveyor and truck cases include cost of a small bucket wheel loader and slurry pit for ore

disaggregation located at the washer. The cost of roads for trucks is not included, but would be a significant cost.

The combined mining cost of draglines with ore pumping, compared to bucket wheel mining and ore conveying, would be about $2.25 and $2.70 per ton product, respectively. The main cost disadvantage of the latter is the high capital cost of the wheel loading plus conveyors.

Energy Use - The conveyor method requires about 11.2 KWH per ton of product compared to about 17.3 KWH per ton for pumping. The conveyor method uses less energy because only matrix is transported. Pumping is conducted at only 25-30 percent solids and the cost to pump the dilution water is substantial.

Water Use and Conservation - The use of water as a medium of transport in pumping does not consume water. The majority of the water is used and recycled. The only way to reduce consumption of water is to eliminate wet disaggregation of the matrix and the resultant formation of clay slimes. Slimes consume water by chemisorption of the water molecules, making them unavailable for immediate reuse. These subjects are discussed under beneficiation alternatives. The alternative ore transportation systems are similar in effect on water use since in each case the ore is disaggregated.

Environment - Pumping and conveying alternatives would each eliminate about 15-20 acres of wetland vegetation due to construction of stream crossings. It is assumed the construction of truck crossings would eliminate some greater amount due to the need for heavy duty bridges on pilings or culverts with approach fill. As pipelines and conveyer systems would cause less physical damage to floodplain slopes and would span the stream channels, construction impacts related to these alternatives are expected to be relatively short-term. Swamp and marsh vegetation has the capacity to readily re-establish itself where seed sources are nearby, stable substrates occur and suitable hydroperiods are attained. Construction and removal activities related to truck crossings are expected to physically disturb both floodplain slopes and stream bottoms and would represent more extensive and longer-term disruption of wetland areas.

The pumping and conveyor alternatives each offer a potential for spillage of transported materials at stream crossings. Extensive spills of truck transported materials into streams is considered remote. The greatest potential for adverse effects related downstream sedimentation by spill materials would appear to be associated with pipe-wall rupture in the pumping alternative if secondary protective measures fail (e.g., double wall pipes at crossings as proposed by Swift). Conveyor system failure at a stream crossing offers a somewhat lesser potential for downstream sedimentation as the transported matrix would not be slurrified. Long-term impact of any matrix spillage would necessarily depend on volume of material reaching stream systems.

The only alternative with significant implications for addition to air pollutant burdens at the mine site is truck transportation alternative. The heavy, off-road 55-ton trucks are assumed to be diesel powered and continuous operation of such vehicles over the mine life could be expected to contribute significant nitrogen oxides, hydrocarbons, carbon monoxide and particulates as exhaust emissions. Significant contributions of fugitive particulates could also be expected from constant truck traffic on unpaved mine roads.

6.3 Selection of Optimum Alternative

The cases of pumping, conveying, and trucking matrix to the washer are compared in Table 6-B.

Table 6-B Comparison of Ore Transportation Alternatives

Item/Case	Pumping	Conveying	Trucking
Cost $/ton, Product	$ 0.92	$ 0.88	$ 1.33
Energy Use, KWH/Ton	17.3	11.2	N/C
Water	E	E	E
Environment	S	B	P
Operational	S	U/P	P

Rates: B-best, S-satisfactory, P-poor, E-equal
N/C-not considered, U/P-unproven in phosphate

Due to lower energy costs, transport of ore by conveyor is the most economical alternative; however, the operational viability of this method is unproven. The problem associated with transferring the ore from the dragline to the conveyor and the need to relocate the conveyor continuously as mining advances are significant disadvantages of the conveyor transport method. The continuing increase in power cost makes further study of this alternative prudent. However, in view of the proven reliability of pumping and its compatibility with the dragline and dredge mining alternatives, the ore pumping alternative is currently the most satisfactory ore transport method.

7. BENEFICIATION PROCESS ALTERNATIVES

7.1 Background

The purpose of beneficiation is to reject the maximum amount of contaminants while recovering the maximum amount of phosphate from the ore. These objectives are to be achieved at optimum cost considering the end use of the rock product. The processes employed are to be energy and water use efficient within proven state-of-the-art technology.

Phosphate ore beneficiation is technically complex and is constantly under study, not only to apply known techniques to newer

ore bodies such as the Swift case, but also to improve present methods. There are many combinations and permutations of established unit operations techniques which may be applied to the same ore body with similar results. Thus, certain flowsheets may differ substantially in sequence of unit operations, use different equipment, but yield equal recover, cost and water use results. These variations are not considered as beneficiation alternatives in this study. Conventional beneficiation employed by Swift is broadly defined as wet disaggregation (water medium) followed by screening and flotation separation of the phosphate minerals from the gangue.

Alternative techniques are those which deviate significantly in the medium used for separation, and the physical and/or chemical separation techniques employed. This definition limits the alternatives to the following processes:

Conventional Beneficiation - This process consists of disaggregation of the matrix with water. Clay slimes are separated physically and coarse pebble is removed by screening. Phosphate particles are separated from sand gangue by flotation process.

Total Acidulation of the Matrix - This is an experimental process which treats the total ore, as extracted from the ground, with a strong acid to convert the phosphates to phosphoric acid. Several versions of this approach are being studied by the U. S. Bureau of Mines and others.

Blast Furnace - In this process low grade phosphate material is converted to phosphorous by high temperature decomposition in a furnace and is common in Tennessee and in western states phosphate operations. A few operate in Florida.

Primary constraints are P_2O_5 recovery, efficiency cost, product grade, and product quality. Energy use, water use, environmental constraints, and safety are considered further only if primary constraints.

7.2 Process Assessments

Conventional Benefication - This method meets all the constraints. Recovery ranges from 65-70 percent of the total phosphate in the ore. Direct costs for washing, flotation, and directly related functions range from $3.50 - $4.50 per ton.

Product grades and quality are acceptable in the market place. Energy use is in the range of 55-65 KWH per ton of product. Water use within the process is not wasteful. The techniques and equipment used are safe and no hazardous conditions for employees are created. The primary environmental hazard typically associated with this process is above ground storage of waste clays. The possibility of dam failure, however remote, poses a potential for significant damage to aquatic ecosystems and degradation of water quality in receiving water bodies. The proposed action of Swift, however, of utilizing only an initial settling area for plant start-

up purposes and subsequent disposal of clays in sand/clay mix landfill further reduced the potential for dam failure and the possibility of intensive environmental damage.

Total Acidulation - This alternative is a direct digestion of the total ore with sulfuric acid to recover the P_2O_5 as phosphoric acid after filtration to remove gypsum, sand and other acid insoluable constituents. The acid is contaminated and must be cleaned by a solvent extraction process. The process is experimental and very little is known about the recoveries, cost or operating problems. Since the total ore is dissolved, no P_2O_5 is lost in the slimed, flotation tailings, or low grade pebble. Losses in the range of 20-25 percent occur in filtration, digestion and acid cleaning compared to 3-5 percent normal losses. Recovery of P_2O_5 by direct acidulation may be 10-15 percent greater than by conventional processing, considering mining and beneficiation recovery. Cost would be high due to the presumed requirement for matrix drying to allow grinding, higher sulfuric acid use, and extensive solvent extraction expense. To achieve proper dissolution, the matrix must be ground to fine particle size. In the natural state, the ore is about 20 percent moisture and sticky, preventing efficient grinding. Water addition dilutes the phosphoric acid making weak acid which is unsatisfactory. Drying the ore is very expensive and energy consumptive. The matrix contains significant amounts of carbonates of calcium and magnesium which consume sulfuric acid, resulting in higher use of sulfuric acid. Acid consumption may be six times higher than that used in conventional processing. The extensive use of sulfuric acid offers significant problems in air and water pollution control. This process has promise, but requires additional research and development to fully evaluate.

Blast Furnace - Furnaces require feed in the range of 45-50 BPL with the proper ratio of silica to P_2O_5. Iron contamination results in losses of P_2O_5 as ferrophos. Thus raw matrix in the range of 18 BPL, as in the Swift case, is unsatisfactory to directly feed to a furnace and must be beneficated (concentrated). Benefication, furnace burden preparation, and furnace operation, are expensive and energy intensive. This is not a feasible process alternative.

7.3 Selection of Optimum Alternative

The alternatives to conventional beneficiation do not offer any effective solutions. The total acidulation process is only experimental and not available for use at this time. Furnace alternatives are cost and energy intensive and unsatisfactory for this ore body. Thus, conventional beneficiation is considered optimum.

8. PROCESS WATER SOURCE ALTERNATIVE

8.1 Background

The process water supply objective is to provide water to the mining operation of sufficient quality and quantity to optimize operational and mineral recovery efficiency while conserving the regional resource. The following supply alternatives are considered:

Use of Surface and Ground Water (Swift Proposal) - The alternative, proposed by Swift, relies primarily on ground water from the deep Floridan Aquifer. After the third year of operation, a below-ground reservoir constructed by Swift would be used to store a portion of the surface water from the East Fork of the Manatee River. After the fourth year, this surface water would be used for a portion of the total water requirement of the mine replacing some ground water.

Total Requirement from the Deep Floridan Aquifer - This alternative is proposed by Swift for the first three years of operation until the surface water aquifer is available to supplement the ground-water supply.

Use of Surface Water in Rainfall Catchment - This alternative assumes that exclusive use of regional and onsite drainage supply, and excludes all ground water diversion except that required for potable use.

Use of Water from the Surficial (Water Table) Aquifer - This alternative would depend on seasonal rainfall and would require 300 containment wells.

8.2 Supply Source Assessments

Utilization of Surface and Ground Water - The balance between water use and availability will depend on the fluctuations in rainfall that generally occur from year to year. Sufficient reduction of ground water in a drought year would cause constraints in water availability and use. The water supply plan selected by Swift, which has the approval of the Southwest Water Management District, requires an average of 11,207 GPM (total water required to make up losses to the system from entrainment and disposed waste clays, sands seepage losses, drying losses, etc.). Of the 11,207 GPM, 2,207 GPM are estimated to be available from the naturally occurring moisture within the ore transported to the plant. After the third year, 2,000 GPM of the remaining 9,000 GPM would be supplied from the surface water reservoir, thus reducing the ground water demand from the Floridan Aquifer to 7,000 GPM. Swift has indicated, based on preliminary process design, a minimum of 4,149 GPM of high quality water (Tannin free) would be required for the flotation process of ore beneficiation. The remaining water needed to make up losses to the system may be of lower quality.

Energy requirements of water pumping are relatively low due to

the high efficiency of large pumps. The cost of pumping 2,000 GPM of water, approximately 3/4 of a mile from the reservoir to the plant site, would be approximately $0.0085 per 1,000 gallons, or $9,000 per year. This is about 30 percent less per gallon than water available at the plant site because there is less head to overcome in pumping water from a reservoir than from a groundwater well. The well field in the Swift permit would require pumping water 3/4 of a mile to the plant site, which would cost about $63,000 per year. The total cost is then $72,000 annually. These cost estimates are mostly for power. This cost is acceptable when considering the quality and quantity of the water needed for beneficiation.

Total Requirements from the Deep Floridan Aquifer - Swift's alternative would provide maximum use of groundwater for the first three years of operation while the surface reservoirs were being constructed. This alternative places a greater stress on the groundwater supply than that of using in part or total surface water, while providing the high quality water needed. Constraints on this alternative, however, involve not exceeding the permitted maximum withdrawals on either a daily or average annual basis. Southwest Florida Water Management District consumptive use permit allows Swift to withdraw 12,960,000 GPD maximum combined average annual, with a maximum combined withdrawal rate not to exceed 20,480,000 gallons during a single day. Wells installed to supply nonpotable water for the mine and processing facility have an overall capacity of 35,412,520 GPD. Swift's approximate cost of pumping 900 GPM from the deep well 3/4 of a mile to the plant site would be $80,000.

Use of Surface Water in Rainfall Catchment - The rate of rainfall catchment from the mining system in an average 50-inch rainfall year is 3,458 GPM. Assuming no losses due to discharge, if this were supplemented by the surface water system with 5,542 GPM to fulfill the total makeup requirements of 9,000 GPM, no groundwater withdrawal would be necessary except that for potable use. In order to make up the additional surface water, further diversion of the surface water system on site would be required. This could be done either by off channel methods to the North Fork of the Manatee River, such as that proposed for the East Fork by Swift, or by construction of an impoundment or impoundments that would enable Swift to flood a portion of the water course as a reservoir. Constraints on building a dam within the stream channel would include inundation of a part of the environmental system within the channel on the site; significant reduction of the amount of surface water downstream by 7,000 additional GPM above that planned by Swift; and possible interference with the water users downstream, especially in a drought year when demand would be greatest. The capital cost for construction of a 700-acre impoundment, capable of containing the total site runoff for process use, would be about $700,000. The cost of constructing impoundments would be $1.8 million, for a total of $2.5 million. The cost of pumping this water from the selected site or sites of impoundment is assumed to be proportional to that of pumping from the surface water impoundment proposed by Swift, or $47,000

per year. The more dependent the water source is on rainfall, thc less reliable it is. Surface water would not meet the quality needs of the flotation circuits within the plant and water treatment would be necessary to make this water acceptable. It would require further engineering design and study to estimate the cost of the water treatment facilities.

Use of Water From the Surficial (Water Table) Aquifer - The quality of the water in the surface water aquifer is equal to that of the Floridan Aquifer for purposes of process use. Water quantity and dependability would vary with the seasonal rainfall pattern. There would be essentially no impact on the deep Floridan Aquifer system. Assuming an availability of water per well, similar to that proposed by Swift in the recharge system, approximately 300 wells would be required to make up a system spread over the property. Generally, there is not enough water available in the surficial system to supply 300 wells. The availability of the well water would rapidly diminish as mining progresses. This factor diminishes the practicality of this alternative. Pumping costs would exceed those of the deep aquifer system, primarily because of the relative inefficiency of a large number of small pumps pumping water through pipes with friction loss at a considerably greater distance to the plant. These costs (disregarding the capital investment costs) for power would be about $81,000 per year above that of having large deep wells near the plant for a total pumping cost of $161,000 per year.

8.3 Selection of Optimum Alternative

Table 8-A compares the quality, dependability, energy cost and resource impact of the water supply alternatives. The groundwater resource, whether from the shallow or deep aquifer, is presumed to be of highest quality. The availability of water from the deep aquifer is assumed the most dependable.

Swift's base case (Alternative 1) uses water from both the groundwater and surface water. This alternative provides for a dependable source of sufficient high quality water for the benefication process and reduces the impact on the deep aquifer compared to the exclusive use of groundwater (Alternative 2). Pumping costs are also less for this alternative relative to groundwater pumping alone.

Alternative 2 impacts only the ground-water resource in the deep aquifer. This alternative provides for a dependable source of high quality water. Pumping costs are slightly higher than for Alternative 1. The impacts of groundwater pumping are acceptable for the first three years, but for the long term, Alternative 1 is preferred because of its reduced impact on the deep aquifer.

Alternative 3 has the lowest pumping costs but is not acceptable in terms of water quality or dependability. In addition, this alternative has the potential of reducing the downstream surface water supply, would destroy hardwood floodplains by reservoir construction, and has not been proven technically feasible.

Alternative 4 has the highest pumping costs of all the alternatives and would not provide a dependable source of water for the operation. In addition, this alternative would have an adverse impact on the maintained vegetation on-site because of drought conditions imposed on the surface soils for the 20-year mining period.

In view of these considerations, the base case as proposed by Swift (Alternative 1), is the optimum blend of various resource uses and power cost considerations. The mitigative action of implementing recharge wells makes this alternative even more attractive.

Table 8-A Comparison of Alternatives for Water Supply

Alt.	Quality*	Dependability	Resource Impact	Pumping Cost
Alt. #1	Excellent GW Poor SW	Dependable	G/W and S/W	$72,000
Alt. #2	Excellent	Dependable	G/W only	80,000
Alt. #3	Poor	Not dependable	S/W vegetative system & down-stream use	47,000
Alt. #4	Excellent	Variable	Vegetative impact	161,000

*Quality is expressed in relative usefulness in the amine circuit of the flotation system.

9. WASTE DISPOSAL/RECLAMATION ALTERNATIVES

9.1 Background

The objective of the waste disposal/reclamation plan is to dispose of the sand and clay wastes in such a way as to economically restore disturbed land to a productive state, considering both existing and created environmental systems.

The selection of waste disposal methods and sites is the first step in the alternative assessment process, followed by alternative means of physically restructuring the disturbed or mined areas, and finally a revegetation alternative selected to match the intended use of the reclaimed site. In actual practice, alternative selection proceeds concurrently at all three levels.

In disposing of the sand and clay wastes generated at the beneficiation plant, a mining operation has two basic alternatives; 1) disposal of the two wastes in separate areas, and 2) disposal of a mixture of the two wastes in the same area.

Once wastes are placed in disposal areas, a variety of physical restoration alternatives are available for subsequently reclaiming the areas. The physical restoration alternatives for the three types of landfills as well as for the case in which no backfill is used, i.e., lake areas, are listed below:

- Above Ground Clay Settling Area
  - (1) Development of a surface crust of clays
  - (2) Capping with overburden
  - (3) Capping with sand tailings
  - (4) Capping with topsoil
  - (5) Mixing a thin layer of sand with surface clay

- Sand Tailing Landfill
  - (1) No capping material
  - (2) Capping with overburden
  - (3) Capping with topsoil
  - (4) Mixing a 5 percent or more clay amendment with the surface layer of sand.

- Sand/Clay Mix Landfill
  - (1) No capping material
  - (2) Capping with sand tailings
  - (3) Capping with overburden
  - (4) Capping with topsoil

- No Landfill (Land and Lake Area)
  - (1) Contouring of spoil windrows to form relatively narrow peninsulas in lakes
  - (2) Dredging of interior spoils to form larger land and water areas
  - (3) Minimum restructuring

The range of revegetation alternatives available are summarized as pasture, forestry, citrus, cropland, wetland, and natural or volunteer establishment. The feasibility of these types of vegetation depends primarily on the nature of the surface soils. However, feasibility is also influenced to some degree by the nature of the underlying landfill material.

9.2 Waste Disposal/Reclamation Type Assessments

Waste Disposal

Separate Sand and Clay Disposal Areas: For purposes of this analysis, it was assumed that all sand tailings would be disposed of in mined-out pits filled above grade to the point where capping with overburden remains possible. Filling to approximately 10 feet above grade would leave sufficient overburden in protruding spoil piles to allow capping the sand tailings to an average depth of two feet. Given these assumptions, approximately 3500 acres of the total 6624 mined acres would be required to accommodate the sand tailings produced during the life of the mine.

Since no mined-out void is available initially, a dike is constructed on unmined ground to enclose a clay settling area for start-up operations. Swift's plan calls for this area to cover 480 acres. In order to confine all the clay wastes generated over the life of the mine in this area, and in the 3124 acres of mined-out pits not used for tailings backfill, confining dams would have to be about 50 feet high. Under this alternative a total of 7104 acres would be required for waste disposal, 480 of which would be otherwise undisturbed land.

The option of using only 30 foot high dams to confine the clays was considered as an alternative. Using this height of clay fill, calculations indicate that 3497 acres of unmined land and 3124 acres of mined land would have to be committed to clay waste disposal for 6621 total acres. Total acreage disturbed, including tailings, would be 10,121 or 97.4 percent of the site. Obviously this alternative would make it impossible to preserve areas of environmental value on the site. For such areas to be preserved, dam heights would approach the 50 foot height previously mentioned.

Conventional waste disposal has the advantage of utilizing time-tested technology, at an acceptabe cost. In addition, separate disposal of the two wastes would likely facilitate recovery of residual phosphate from either fraction should future technological advances make this feasible.

The practice of disposing of clay wastes in above ground areas has the serious disadvantage of potential dam failure. To minimize such risks, extensive engineering, design and monitoring is necessary. In addition, there are aesthetic objections to the high dams required for conventional clay waste disposal.

Finally, land committed to clay settling areas is removed from productive use for a longer period due to the length of time necessary for reclamation.

Sand/Clay Mixture Impoundment: Swift's waste disposal plan allows an initial 480-acre conventional above-ground settling area to provide for clay disposal before the sand/clay mix disposal method becomes operational. Approximately 848 more acres are used to provide for disposal of sand tailings generated in excess of the requirements of the sand/clay mix procedure. Approximately 5,426 acres are devoted to combined sand/clay mix disposal areas. In this method, the sand tailings are mixed with pre-thickened clays and allowed to backfill previously mined areas.

The advantages of this alternative are that the risk of dam failure is substantially reduced, water recovery efficiency is likely to be enhanced, and disturbed land can be returned to productive use at an earlier date. Clays in the mixture are expected to reach 30 percent higher solidification more quickly than is possible for clay in conventional settling areas. As a result, retaining dikes for sand/clay disposal areas are only 14 feet in height,

primarily to allow for subsidence as the mixture continues to solidify. There are indications that the agricultural land use potential of sand/clay disposal areas is broader than that of conventional clay settling areas.

The disadvantages of this alternative include the inevitable field application problems and uncertainties that face every innovative process. Cost may be excessive. In addition, combining the wastes would likely increase the difficulty and expense if future phosphate recovery is attempted.

Given proper physical restoration and revegetation selections, both the conventional and sand/clay mix alternative methods of waste disposal are capable of meeting the applicant's stated objectives. The choice of the optimum waste disposal/reclamation alternative must also take into account the reclamation considerations that follow.

Physical Restoration

Above Ground Clay Settling Area: The surface of clay settling areas in Central Florida's phosphate mining area have generally been stabilized either by drying of the surface into a crust or by capping with a layer of sand tailings. The crust development technique has distinct agricultural advantages in that the fertile clays are left as the surface soil. The clay soil is, however, heavy and difficult to cultivate and thus may be relatively inaccessible to vehicular traffic during wet weather. A period of several years may be required to form a surface crust of acceptable stability.

Partial capping of clay settling areas with unconsolidated overburden has also been occasionally practiced. Surface stability is improved somewhat by this method and the overburden is an acceptable medium for plant growth, though not the equal of phosphatic clay in terms of fertility, moisture and nutrient retention properties.

Capping clay settling areas with a relatively thick layer of tailings sand speeds up the reclamation process and produces an area with better surface (though not necessarily subsurface) stability. However, this technique has the serious disadvantage of covering the moist, fertile clays with droughty, less fertile sand tailings. Tailings sand has been shown to be far inferior to native Florida soils in terms of crop production potential (Barnett, 1977).

Capping clay settling areas with topsoil is a physical restoration technique that has not been employed on a field scale by the industry. An evaluation of this technique must consider the nature of the existing surface soils on the site. The surface soils on Swift's Duette mine tract have been characterized as predominantly acid sand low in organic matter, clay, and natural fertility (Swift Development of Regional Impact, 1978; Zellars-Williams, 1977a). Certain soils associated with wetland areas tend to be higher in

organic matter and natural fertility, but since most of these areas are excluded from the mining plan, very little of this soil would be available for use as capping material. Thus, capping clay settling areas with the typical flatwoods soils would result in surface soils inferior to the clay in terms of fertility, nutrients, and moisture holding capacity. On the other hand, the top soil would be superior to the clay in terms of tillage characteristics and the cap would improve surface stability to some degree. Establishing a topsoil cap approximately one foot in depth involves the stockpiling, transportation, and spreading of approximately 1613 cubic yards of material per acre. Conservatively assuming a cost of $0.50 per cubic yard, the cost of topsoil capping can be estimated at over $800.00 per acre. In view of the questionable benefits in terms of soil productivity, these costs do not appear warranted.

As with topsoil capping, mixing a thin layer of sand tailings with the surface clay is not a technique that has been used on a field scale by the phosphate industry. The intent is to blend the fertility, moisture retention, and nutrient retention properties of the clay with the excellent tillage and aeration properties of the sand. The problem lies in depositing, spreading, and incorporating the sand with the dry surface clay so as to achieve a relatively homogeneous mixture. The technology for accomplishing this has not been demonstrated. One technique would involve transporting the sand with pans, spreading it with bulldozers, and incorporating it by deep plowing and/or rotovating. Assuming that a six-inch layer of sand would be used to achieve a 1:1 mixture of sand and clay in the surface foot of soil, the cost of transporting and spreading the material can be estimated at $400 per acre and the cost of incorporation at $200 per acre. If a homogeneous mixture were not achieved, the problems of managing the resulting heterogeneous soil would be severe.

Sand Tailings Landfill: Sand tailings landfills have traditionally been reclaimed either simply by grading the sand to achieve a level surface or by capping the sand tailings with a layer of overburden derived from spoil piles in or around the landfill. Capping with overburden provides a surface soil of acceptable potential productivity. Though initially devoid of organic matter, overburden generally has higher levels of clay and plant available nutrients than the original sandy topsoil. The cost of establishing an overburden cap one foot in depth has been reported to vary from about $600 to $1500/acre (Zellars-Williams, 1977b), depending on the percent of the total area spoil piles occupy at natural ground level. A portion of this cost would be borne in grading the overburden to slopes required by county and state regulations. The cost directly attributed to forming the overburden cap are justifiable in terms of soil productivity.

The alternative of topsoil capping is not simple to evaluate. As previously mentioned, overburden is frequently agronomically superior to the available topsoil. Since much of the overburden capping costs must be borne, anyway, in conforming to slope requirements, the cost of capping with topsoil is actually

superimposed to a large degree on this cost. Unless special conditions exist, such as the distinct superiority of the topsoil, the cost of topsoil capping is probably not justified.

University of Florida studies have shown that 5 percent clay amendments significantly improve the moisture and nutrient retention properties as well as the available P_2O_5 levels in sandy soils (Diamond and Fiskell, 1965; Saxena, Hortenstine, and Mansell, 1971). The economic feasibility of applying and incorporating such amendments has not been demonstrated and the cost of drying and pulverizing the phosphatic clay prior to mixing makes such a procedure impractical. One possible technique is to intermittently spray-irrigate a dilute clay suspension over the sand tailings and incorporate the clay by rotovating or deep discing. Assuming a 5 percent solids clay suspension and a cost of $10 per acre-inch for spray irrigation, the cost of applying 50 tons of clay per acre can be estimated at approximately $90 per acre. Drying periods would be necessary between irrigations and several passes with a disc or rotovator would be necessary for adequate incorporation of the clay. The cost of incorporation may be estimated at approximately $200 per acre for a total cost of about $290 per acre.

This cost analysis is entirely dependent on the ready availability of dilute clay suspension in close proximity to the landfill areas. Otherwise, costs would be much higher. With time, such clay amendments to the surface could percolate downward, leaving a soil residium similar to that prior to clay application. Moreover, utilization of this technique would not eliminate the costs of leveling spoil piles to conform to slope requirements. Finally, although proven to be beneficial, there is no actual data to show that 5 percent clay amendments on sand tailings result in soils equal in potential productivity to overburden or native soils.

Sand/Clay Mix Landfill: Since the sand/clay mix process is a recent innovation, there are few examples of the field application of this technique. If the mixture is deposited primarily below-ground in mined-out pits, as the material dewaters, the landfill subsides. This subsidence necessitates the deposition of sand tailings and/or overburden to bring the landfill back to original grade. An alternative method of sand/clay disposal is to construct low retaining dams or levees around mined-out areas and fill these areas sufficiently above grade to allow for eventual subsidence to near original ground level. Capping of such areas would then not be an absolute necessity.

Sand and clay mixed in the ratio of 2.5 sand to one clay (by dry weight) is projected to be a superior soil to both the overburden and the native soils on the site (Zellars-Williams, Inc. 1977a). This projection is based on the assumption that a relatively homogeneous mixture of soil and clay will be attained.

No Landfill (Land and Lake Area): The most commonly used physical method of land restoration, where no backfill is used, is simply

to grade the spoil piles in the mined pit to approved slopes. When the area fills with water, the resulting terrain is a series of water bodies approximately the width of a mine cut (200-400') alternating with land peninsulas of approximately the same width.

An alternative method to creating water bodies is to employ a dredge to remove the interior spoils and deposit the dredged material around the margins of the water body. This method results in broader expanses of water surrounded by more concentrated land areas similar in the configuration to natural lakes. This technique is generally regarded as more desirable for land that is to be reclaimed as residential developments. The cost of this physical restoration technique, however is much higher than the finger lake method.

Cost estimates have been reported of approximately $20,000 per acre of land formed by spoil dredging to about $3,500 per acre of land in finger lake areas (Zellars-Williams, Inc. 1977b). For the agricultural reclamation areas, this cost differential rules out the use of a dredge in land and lake reclamation.

A third alternative has been suggested by Swift in its Application for Development Approval (DRI). Noting that many old mined-out areas have revegetated naturally, particularly when adjacent to natural flood plains, Swift has suggested the alternative of allowing a land and lake area to revegetate itself. The proposed area is adjacent to a preserved flood plain. Only very minimal earthmoving is intended in order to push down the sharp droughty tops of spoil piles.

Because of their limited accessibility and dense volunteer vegetation, such naturally revegetated areas are regarded by some as wildlife refugia. In addition, the irregular relief of naturally reclaimed areas is regarded as an aesthetic plus by many observers. In a reclamation plan which incorporates environmental productivity objectives, this alternative warrants consideration.

Revegetation

Pasture: The planting of improved pasture is the revegetation option most frequently used by the phosphate industry. Several reasons can be cited for the predominance of pasture plantings: 1) Forage species can be selected that are adaptable to all the possible reclaimed soil types. 2) The plantings have satisfied local and state reclamation standards. 3) Pasture plantings are effective in stabilizing reclaimed soils. 4) Production of beef cattle is one of Central Florida's agricultural bases and reclaimed pasture land is very much in demand among local cattlemen. 5) Finally, permanent grass sods, especially those which include legumes, are acknowledged to be very effective in encouraging the development of soil organic matter in which all reclaimed soils are initially deficient.

Despite the many advantages of pasture plantings, vast expanses of pasture provide no cover or habitat for most native wildlife

species. In addition, many observers object, on aesthetic grounds, to the relative absence of trees from reclaimed landscapes.

Forestry: Commercial forestry is not a revegetation option that has been frequently used by the phosphate industry and tree plantings on reclaimed land have been largely scattered plantings in pasture areas. Central Florida is not a traditional silviculture area. Neither the price paid for pulpwood nor the cordwood tonnage produced per acre in Central Florida is equivalent to North Florida where the wood processing yards are concentrated. Thus, even if commercial silviculture is rejected on economic grounds, scattered or strip tree plantings for wildlife cover and aesthetic enhancement remain to be considered. Scattered trees provide less cover for wildlife than forested strips planted at intervals across reclaimed land.

Citrus: Only a few citrus plantings have been made on reclaimed land. Of these, a number have failed, notably those planted in droughty soils of sand tailings or very sandy debris sites. The plantings on overburden have shown the most promise. Given proper site and soil selection, citrus plantings are a possibility on some reclaimed areas. The cost of planting and maintaining a citrus grove up to bearing age has been reported to be over $1600 per acre (Zellars-Williams, 1977b).

Cropland: Very little reclaimed phosphate land is utilized for the production of row crops. Uncapped tailings sand soils are not suited for this purpose although there has been some commercial peanut production on old debris sites. In addition, there have been a few small scale truck farming experiments on reclaimed settling areas in an attempt to take advantage of clay soil fertility. Since sand/clay soils are expected to combine some of the best properties of both sand and clay soils, row cropping of these soils is a definite possibility.

Wetlands: The growing realization of the value of wetlands has led to experimentation with methods of restoring and revegetating both marshes (non-forested wetlands) and swamps (forested wetlands). These experiments have generally followed one of two techniques. One is to restore a shallow aquatic environment during reclamation and allow the area to revegetate naturally. Proponents of this technique point out that many shallow aquatic environments, created inadvertently during mining and/or reclamation, have developed marsh-type vegetation with no further encouragement from man. Instances of natural swamp restoration are less clear-cut. With this in mind, the second technique involves the planting of the desired wetland vegetation in moist to shallow aquatic environments. At present, the state-of-the-art in wetland revegetation provides no definitive guidelines for choosing between these techniques. The technique of natural revegetation is strongest in the case of marshes while it appears that plantings will be necessary in the case of swamps.

Natural Revegetation: Mined areas often develop a dense vegetative cover within a few years after active operations cease. Instances

of natural revegetation to full-grown oaks and pines can be cited particularly when nearby seed sources exist in the form of undisturbed native habitat. Some individuals now support the view that naturally developed, dense vegetative cover is preferable, in terms of wildlife habitat, to conventional reclamation replantings. Selection of such an alternative will require that variances be obtained from both local and state regulatory agencies.

9.3 Selection of Optimum Alternative

In the preceding discussion, a number of the available physical restoration and revegetation alternatives can be seen to be inconsistent with the applicant's objectives. Considering all three levels of alternative selection - waste disposal, physical restoration, and revegetation, a set of the alternatives capable of meeting the applicant's goals can be established. Two cases have been selected for final comparison.

Case I - Case I may be described as the best case application of conventional waste disposal and reclamation techniques. Under this case, clay and sand wastes would be disposed of in separate areas. Except for the required initial clay settling area on natural ground, waste disposal would be confined to mined-out areas. This requires the construction of approximately 3,604 acres of conventional clay settling areas with dams averaging 50 feet in height, of which 480 acres would be on natural ground. The remaining 3,500 acres of mined-out land would be used for sand tailings disposal.

All clay settling areas would be reclaimed by the crust development technique so as to leave the fertile clays in the surface soil. Sand tailings landfills would be capped with overburden to an approximate depth of two feet. It was assumed that reclamation of the approximately 255 acres required for the plant site and support facilities would be the same for both cases.

All reclaimed areas initially would be planted in forage species. As is frequently practiced, scattered tree plantings would be made in reclaimed pasture areas at a density of two trees per acre, of which half would be 2"-4" transplants and half would be potted seedlings. Since wetland restoration is not currently part of conventional reclamation technology, it was assumed that no areas would be restored as wetlands. Also, no areas would be allowed with minimal reclamation to revegetate naturally since this is at variance with current local and state reclamation standards.

Case II - Case II is the Swift plan. Under this plan, the sand/clay mix technique is the primary waste disposal method, requiring a total of 5,426 acres, of which all but 200 acres are in mined-out areas. An initial 480-acre conventional clay settling area with a dam height of 30 feet is required on unmined land. Approximately 848 acres of conventional sand tailings disposal areas in mined-out pits are also elected. The remaining 574 acres of mined-out land is not utilized for waste disposal.

All sand/clay landfills are reclaimed without the use of capping material. The single clay settling area is reclaimed by the crust development technique and all sand tailings disposal areas are capped with approximately two feet of overburden. The acreage not required for waste disposal is reclaimed as land and lake areas. Of this 574 acres, shallow zones amendable to marsh restoration would be created on approximately 90 acres along the margins of four reclaimed lakes and a 100-acre area would be physically altered only by the partial leveling of spoils to provide an area amendable to natural revegetation. The 255 acres required by the plant site and support facilities will be physically reclaimed by conventional means of dismantling facilities, grading to approved slopes, etc.

Revegetation plans for Case II include the planting of 5,928 acres of improved pasture with a mixture of grass and legume species. Mixed forest strips totalling approximately 58 acres would be planted in upland reclaimed pasture areas. Approximately 485 acres of forested wetlands would be planted, primarily along major drainage swales and also along a restored segment of the East Fork Manatee River. Approximately 538 acres of shallow aquatic environments created in sand/clay landfills would be allowed to revegetate naturally. Along with the 90 acres of shallow zones created in the margins of reclaimed lakes, this constitutes a total planned marsh restoration of 628 acres. The 100-acre land and lake area subjected to only partial spoil grading would be allowed to revegetate naturally. All the land areas associated with the remaining 384 acres of land and lake areas would be grassed.

The two cases must be judged on the basis of their relative costs and on their ability to achieve he applicant's economic and environmental objectives for the reclaimed site. Ideally, the lowest cost method will produce the most favorable results. In lieu of such ideal conditions, the economic and environmental productivity of the reclaimed site should justify the added cost incurred.

Developing precise figures for waste disposal/reclamation costs requires input data derived from detailed engineering studies. This is, of course, not possible when comparing two conceptual alternatives. A further complicating factor in this analysis is that there is very little actual field experience with the sand/clay mix technique upon which to base cost estimates. Nevertheless, it is possible to make approximate cost comparisons based on published methods of estimating mining and reclamation costs (Zellars-Williams, Inc., 1977b; Zellars-Williams, Inc., 1978). Table 9-A summarizes the cost comparison between the two described cases based on these methods of cost estimation.

According to this cost comparison, Swift's selected waste disposal/reclamation plan will cost $0.21 more per ton of product produced or approximately 20% more than conventional waste disposal/reclamation techniques.

Table 9-A . Cost Comparison Between Alternative Cases

	Total	Cost/Ton Product	Total	Cost/Ton Product
	--------Case I ---------		--------Case II ----------	
Waste Disposal/Physical Restoration				
• Conventional Clay Settling Areas	$42,365,000	$0.689	$ 3,026,000	$0.049
• Sand Tailings Disposal Areas	$21,414,000	$0.348	$ 4,704,000	$0.077
• Sand-Clay Mix Areas	-	-	$68,504,000	$1.114
• Land and Lake Areas	-	-	$ 760,000	$0.012
• Plant Site and Support Facilities	$ 128,000	$0.002	$ 128,000	$0.002
Revegetation	$ 2,797,000	$0.046	$ 2,663,000	$0.043
Grand Total	$66,704,000	$1.085	$79,785,000	$1.297

In rating the two cases for achievement of economic goals, Case II must be given the preference. The approximately 5,400 acres of sand/clay soils planned in this alternative are projected to be more productive than the soils which result from conventional waste disposal/reclamation techniques. Moreover, under Case II, disturbed land will be returned to a productive use at an earlier date than for the conventional waste disposal case.

The risk of a dam failure and its resulting environmental (and economic) damage is greater in Case I. Case II has the most obvious advantage over Case I in the area of revegetation efforts to mitigate the loss of natural communities to mining. In Case I, all reclaimed areas would be improved pasture resulting in a permanent loss of 364 acres of marsh and 476 acres of swamp. As river swamps and marshes were found to be the most productive wildlife habitats of the site, the reduction would significantly reduce the long-term carrying capacity of the mine site. In Case II, a variety of revegetation efforts are proposed to attempt re-establishment of destroyed wetland habitat. The Case II planned restoration of over 1,100 acres of wetlands represents a significant contribution towards mitigating adverse impacts of mining on local wildlife populations. Additionally, reforestation strips (hedgerows) in upland areas and abandonment of a minimally reclaimed 100 acre area will provide areas of wildlife habitat not available in Case I.

The advantages Case II offers, in terms of both the economic and environmental productivity of the reclaimed site, appear to justify the added costs this alternative imposes over the more conventional Case I alternative. Case II, therefore, may be designated as the optimum alternative. Due to the conceptual basis of the plan, it is expected that modifications will be made (in practice) in response more detailed engineering and to variables in actual operations. The conceptual approach as outlined by Swift, however, is recommended.

10. SURFACE WATER DISCHARGE VOLUME ALTERNATIVES

10.1 Background

Swift's objective is to keep the amount of discharged water to a practical minimum, dictated by feasible economic limitations, while maintaining the quality of all discharged water at the applicable standards for the receiving water. Following are descriptions of alternatives considered regarding discharges from the mining operations.

Containment of Long Term Accumulation - Alternative one would prevent any process water, or water coming in contact with process material or water, from entering the natural stream system by containing all such water on the property within dikes constructed especially for this purpose. The majority of the water would consist of rainwater falling directly into pools of process water and runoff water from the mined and partially reclaimed areas.

Over the mine life of 21 years, assuming 55 inches of rainfall per year (25-year average includes hurricanes and tropical storms) and 51 inches of evaporation per year, approximately 80,000 acre-feet of water would be contained behind 2,800 acres of storage area, with clear water levels of just under 29 feet behind 34-foot high dikes, thus, the 5 feet of freeboard required would be maintained.

Containment of Short Term Accumulation - The average annual rainfall for the past 10 to 15 years has been approximately 50 inches. This is about five inches less per year than the 25-year average which included hurricanes and tropical storms. This second alternative would contain all rainfall, except for the excessive amounts (five inches) brought by these storms. Given the same 2,800-acre storage area as in alternative one, 19 feet, rather than 29 feet, of clear water would need to be retained behind 24-foot high dikes, of 53,000 acre-feet. This would then entail the discharge of 1.8 CFS (809 GPM) of excess water (five inches) averaged over the entire mine life.

Swift's Proposal of Containment to Offset Evaporation Losses Only - Long-term evaporation rate is about 51 inches per year. Therefore, 51 inches is the water depth lost from open pools of water on the mine site. Since long-term rainfall is 55 inches, four inches per year must be discharged from the pools, as well as all of the water collected as runoff from the mining and reclamation areas. If the short-term rainfall average of approximately 50 inches per year persists, some accumulated runoff would need to be saved (as well as all direct precipitation into the pools) in order to offset evaporation losses, which on the short term average almost 60 inches per year and this would result in less water discharge. Considering the long-term rainfall and evaporation rates, the average mine life discharge would be about 4.5 CFS or 2,023 GPM. Considering the short-term rainfall and evaporation rates, the average mine life discharge would be 3.6 CFS or 1,597 GPM.

No Containment - If all of the long-term precipitation were to be discharged as soon as possible, the average mine life rate would amount to 9.09 CFS or 4,078 GPM. The short-term precipitation average would amount to an average mine life discharge rate of 8.25 CFS or 3,701 GPM. Evaporation losses would then have to be made up from either increased ground water withdrawal or stream water diversion.

10.2 Discharge Volume Assessment

Each alternative is discussed concerning the associated economics, physical liabilities, and environmental impacts, with a comparison of the alternatives presented in Table 10-A at the end of this section.

Containment of Long Term Accumulation - A minimum of 66,624 linear feet of dikes 34 feet high would need to be built at an estimated present value cost of $4.3 million. Since the dikes would be retaining clear water, they would need constant checking and

Table 10-A Comparison of Discharge Volume Alternatives

	Estimated Initial Impoundment Costs	Potential Liability	Effect On Surface Water Quality	Remarks
Alt. 1	$4.3 million	Maximum	None	Loss of resources due to extra impoundment construction.
Alt. 2	$2.1 million	Similar to Alt. 1	Potential for increase in TDS and TSS in receiving stream.	Loss of resources due to extra impoundment construction.
Alt. 3	None	Minimum	Increased potential for increase in TDS and TSS in receiving stream.	Discharge must be acceptable quality.
Alt. 4	None	Minimum	Increased potential for possible increase in TDS and TSS in receiving stream.	Discharge must be acceptable quality.

maintenance as long as they held water as is required by law. The water would evaporate and slowly seep out through the impoundment bottom and the dikes and, after many years, would become virtually empty. The initial dikes would cover mineable reserves. The dikes would have to be removed and then replaced, at some increased cost, after mining.

The environmental impact of this alternative would be minimal barring a dike failure. There would be 2,800 acres of dry land area converted into lakes and essentially removed from the drainage area of the Manatee River system, but this would be a very small percentage of the total drainage area. Impacts on downstream biota or water quality would be negligible. Inundated upland areas would be expected to have natural vegetation eliminated in any case either by mining, waste storage, or water storage.

Containment of Short Term Accumulation - Assuming the same surface area for storage as in alternative one, the length of dikes needed would be the same, but the height would decrease 10 feet to 24 feet, since only 19 feet of water would be impounded. This reduced dike height would result in an estimated present worth cost of construction and maintenance of about $2.1 million.

The liability and environmental impacts would be similar to that of alternative one as would be the increased cost in replacing dikes removed for mining covered reserves.

Swift's Proposal of Containment to Offest Evaporation Losses Only - Assuming rainfall and runoff water is contained only for replacement of that water lost to evaporation, there would be no additional cost incurred for storage needs. Liability would be considerably less than that in alternatives one and two, because there would be no additional dikes.

With increased rainfall induced discharge, there is potential for increased amounts of pollutants in the stream; however, extremely turbid stream water caused by storms could be of lower quality than the process water being discharged.

No Containment - As in Swift's alternative there would be no additional costs incurred for storage of excess water and the liability would not increase over that for alternative three. The impacts on surface water would be in the form of potential for increase in discharge pollutants, which may be offset by dilution due to the large amounts of runoff involved. Additional water would need to be obtained from stream diversion or ground water pumping to resupply that lost to evaporation, which amounts to approximately 7.16 CFS or 3,215 GPM. However, any discharge would have to be of acceptable quality as in the Swift plan. As in other cases, increased discharge is likely to be more significant as it relates to water conservation rather than potential to pollute streams.

10.3 Selection of Optimum Alternative

Table 10-A summarizes the discussed alternatives. The optimum alternative, based on the comparison, is number three. Alternative one is too costly for this type operation and it possesses the potential for dike failure. Alternative two is substantially more costly than alternative three and possesses the potential for dike failure, as in alternative one. A financial or resource loss would also be incurred due to the construction of impoundments over areas containing mineable phosphate ore. The reduced potential for surface water degradation or water conservation is not deemed sufficient to offset the previously mentioned negative attributes. The selection of the third alternative, however, does not completely define it as the optimum possible system. Improvements or modifications possibly can be implemented by Swift, during design or operation, to further feasibly reduce discharge. Alternative four would require additional water to be obtained from either the rivers or deepwells.

11. DISCHARGE POINT ALTERNATIVES

11.1 Background

The objective of the discharge points selection is to maximize the discharge flexibility at the lowest cost for purposes of water conservation and management while meeting water quality standards for the receiving waters. The alternative assessment considered four major discharge plans which utilize one or more of the following discharge points:

Discharge Point	Description
001	Direct to reservoir pool connected to East Fork Manatee River
002	Direct to East Fork Manatee River
003	Direct to North Fork Manatee River
004	Deepwell injection

Figure 11-1 identifies the discharge points used for the various alternatives.

The following alternatives were assessed regarding their ability to achieve the stated objective.

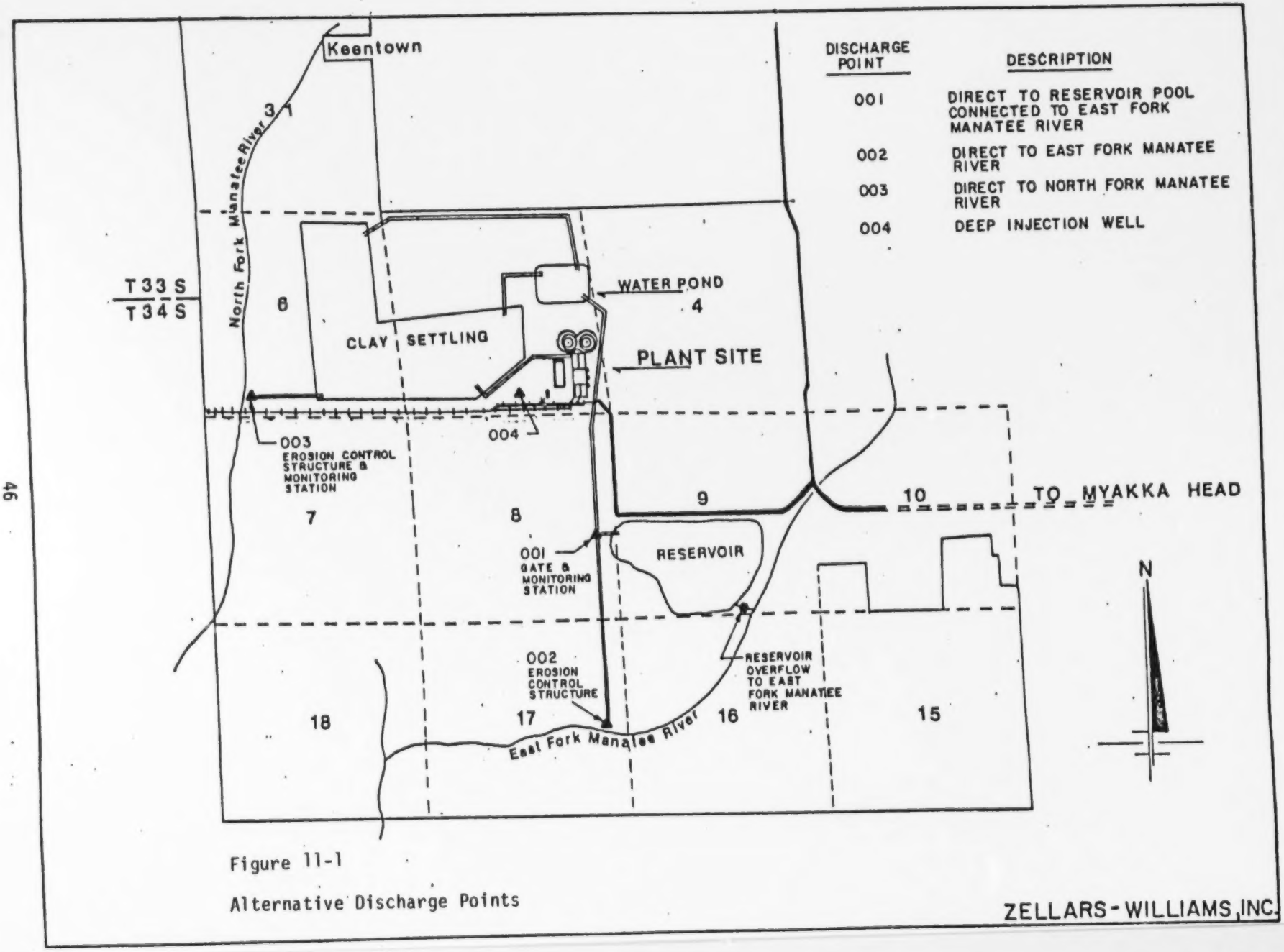


Figure 11-1

Alternative Discharge Points

ZELLARS-WILLIAMS, INC.

East and North Fork Manatee River (1)

Discharge Directly Into Both Streams (A): All discharge water would be channeled directly into both streams over erosion control structures such as weirs using discharge points 002 and 003.

Discharge Directly Into North Fork and Into Pool Connected to East Fork Manatee River (B): Discharge water would directly enter the North Fork from the clay settling area via discharge point 003 as in 1A. Water would also be discharged into the pool connected to the East Fork at discharge point 001 where it could be retained for plant use. During periods when the pool was full, the excess water would flow out of the pool and downstream.

The Proposed Action to Discharge Directly Into North Fork, Into River Overflow Pool When Not Full, and Directly Into East Fork When River Overflow Pool is Full (C): Discharge water would directly enter the North Fork through discharge point 003, as in 1A. When the river overflow pool is not full, water would be discharged into the pool (discharge point 001) to be stored for plant use. During periods when the pool is full, the channel leading into it would be closed. Discharge water would bypass the pool and flow directly into the East Fork over an erosion control structure at discharge point 002.

East Fork Manatee River (2)

Directly Into Stream (A): All discharge water would be channeled over an erosion control structure directly into the stream through discharge point 002.

Into River Overflow Pool (B): All discharge water would be channeled into the overflow pool connected to the East Fork (discharge point 001), where it would be stored for plant use when the pool was not full, and flow out of the pool during periods when the pool was full.

Directly Into Stream When Overflow Pool is Full (C): During most of the year (October to June), the overflow pool would not be full, and discharge water would be channeled into the pool through discharge point 001 to be used by the plant. During July - September, when the pool would be full, the discharge would be diverted directly into the stream over an erosion control structure at discharge point 002.

North Fork Manatee River (3) - All discharge water would be channeled over an erosion control structure and directly into the North Fork at discharge point 003.

Deepwell Injection (4) - All discharge water would be channeled to a holding pond and then pumped down to deepwells and into an aquifer capable of receiving the quantity of water being handled (discharge point 004). This could be an aquifer, but preferably it should be highly mineralized zone below the fresh water zone.

11.2 Discharge Point Assessment

Any water discharged directly into a stream would be permanently lost from the mine water system and, therefore, lost as a potential source of makeup water used to mitigate ground or surface water consumption. Discharge into the stream would be simple and it would eliminate the need for additional water storage areas, which would be expensive and potentially hazardous. Maximum flexibility would be obtained by discharging into both streams. Water discharged into the river overflow pool, when it was not full, could be retained on site and used as makeup process water.

For all cases and locations, considering discharge into surface streams would occur after excessive rainfall events, the volume discharged should not appreciably affect receiving streams as flows would be approaching high flow levels in any case.

Water injected back into the subsurface would have to be of very good quality in order to meet standards, unless the water were to be injected into a highly mineralized zone well below the fresh water level. If this were done, the injected water would be lost from the mine water system as well as the fresh water system. The cost of deepwell injection is also much greater than that of the other alternatives.

11.3 Selection of Optimum Alternative

The optimum alternative based on comparisons presented in Table 11-A would be either 1B or Swift's plan, 1C. Both alternatives maximize water efficiency and minimize discharge. Alternative four is rejected because of increased risk of contaminating the groundwater and the greater capital cost associated with deepwell injection.

All alternatives are acceptable if they are reasonable and if they meet water quality standards, with the exception of alternative four.

Table 11-A Comparison of Discharge Point Alternatives

Alternatives	Discharge Points Utilized	Estimated Capital Cost	Water Mgmt. Efficiency
1A	002, 003	$ 18,000	Fair
1B	001, 003	12,000	Good
1C	001, 002, 003	19.000	Good
2A	002	15,000	Poor
2B	001	9,000	Fair
2C	001, 002	16,000	Fair
3	003	3,200	Poor
4	004	600,000	Fair

12. ROCK DRYING ALTERNATIVES

12.1 Background

The objective is to prepare the phosphate rock for shipment in a condition acceptable to customers while meeting regulatory requirements regarding air pollution. The alternatives selected for assessment, and the rationale for the selection are identified below.

Install Rock Dryer at the Duette Mine - This alternative would minimize the cost of handling rock and would produce a product that meets specifications of present and projected Swift customers.

Ship Wet Rock - This alternative would reduce domestic energy consumption and would eliminate air emissions associated with drying rock and with dry rock handling.

Use Existing Dryer at Remote Location - This approach assumes that there is a phosphate rock producer in Central Florida with dryer capacity available for contract drying.

Install Rock Dryer at Remote Location - This alternative assumes a common location for drying rock which could serve more than one user, thereby preventing an increase in the number of point sources of pollution associated with drying rock and with dry rock handling.

12.2 Rock Drying Assessments

Install Rock Dryer at the Duette Mine - This method would require domestic energy use and would create a stationary source of air pollution.

Ship Wet Rock - Shipping wet rock to all customers may be technically feasible, but Swift would lose customers who cannot use wet rock. Using wet rock in an existing "dry rock" plant requires major process alterations and capital investment. If Swift customers are unwilling to undertake such costs, it will be necessary for the customer to select another supplier. This, of course, disallows Swift a market for the Duette Mine product. Another possibly less significant disadvantage would relate to increased rail shipment costs of wet versus dry product. In the event that overseas customers could be found willing to accept wet rock, Swift would lose the use of existing port facilities presently equipped to handle only dry rock. If it is assumed that wet rock seaport facilities would become available at points of shipment and destination, Swift's competitive position with overseas customers, beyond a radius of 1,000 miles, would suffer because of higher freight costs to ship the excess moisture in wet rock. Points outside this radium include Canada, South America, Europe and the Far East.

As obsolete smaller phosphoric acid plants are replaced with new facilities, it is certain that more wet rock processing will be incorporated and a gradual shift to this more desirable system will occur. Conversion will be slow, however, requiring continued dry rock production. It is concluded that the dry rock production is currently necessary for Swift to economically meet their customer specificatons and that this action can be achieved in compliance with appropriate regulations regarding maintenance of air quality.

Use Existing Dryer at Remote Location - This alternative would introduce additonal cost and energy use for double shipment by rail, shipment of moisture in the wet rock, and double handling at the remote site.

More significantly, there are no known existing facilities in Central Florida with excess capacity for contract drying three million tons per year of phosphate rock. If such facilities were available, it is most probable that they would be several years old and would not have been designed to latest air pollution regulations including Prevention of Significant Deterioration (PSD) and Best Available Control Technology (BACT). Hence, it is most likely that the net contribution to the regional pollutant burden would be significantly greater. Further, the increased emissions would probably exacerbate air quality problems in an area already marginal with respect to attainment of state and federal air quality standards.

Install New Rock Dryer at Remote Location - As with the above option this alternative would lead to increased handling and freight costs due to the double handling, unless the dryer was installed at a port facility. If a port location were chosen, either the same or more restrictive (i.e., non attainment) regulations would apply to the development. It is possible for such a site that already marginal air quality conditions might constrain and force the application of unproven, state-of-the-art air pollution control technology. Any decision of this nature must assume the strong possibility of excessive equipment failure, production curtailment and high pollution control equipment operating cost. If a port location were available with suitable existing and projected air quality conditions, land acquisition costs would be much greater, with possibly only a slight offset in the cost of handling product at the terminal.

12.3 Selection of Optimum Alternative

The proposed action of drying the rock at the mine is the least costly while meeting the objective of providing an acceptable product to the customer. This is shown by comparison with the other alternatives in Table 12-A. The cost of transhipment, primarily the handling of the rock at a separate dryer site, adds more than $1.00 per ton to

Table 12-A Comparison of the Product Specifications, Environmental Impact, Capital Costs, Operating Costs, and Energy Use per Product Ton of the Four Rock Drying Alternatives

Alternate	Product Specifications	Environment	$MM Mine & Mill Capital Cost	$/Ton Mine & Mill Operating Cost*	Per Ton Energy Use**
I	Meets specifications of 2% H_2O	New source of emissions	90.71	9.24	80.19 KWH 414,000 BTU
II	Must accept rock with 13% H_2O	PM emissions reduced substantially and no SO_2 emissions	83.58	7.85	76.414 KWH
III	Meets specifications of 2% H_2O	increased emissions at new location	83.58	10.35(2)	79.29 KWH(3) 414,000 BTU(4)
IV	Meets specifications of 2% H_2O	New source of emissions at another site	83.58	10.35(2)	80.19(1) 414,000 BTU(4)

I	Install Rock Dryer at Duette Mine.
II	Ship Wet Rock.
III	Existing Dryer at Remote Location.
IV	Install Dryer at Remote Location.

(1) Includes 3.77 KWH/ton for new dryer at another site.
(2) Includes $2.50/ton for contract drying at another site.
(3) Includes 2.88 KWH/ton for existing dryer at another site.
(4) Consumed at another site.

* Free on rail at mine site.
** Transportation energy not included.

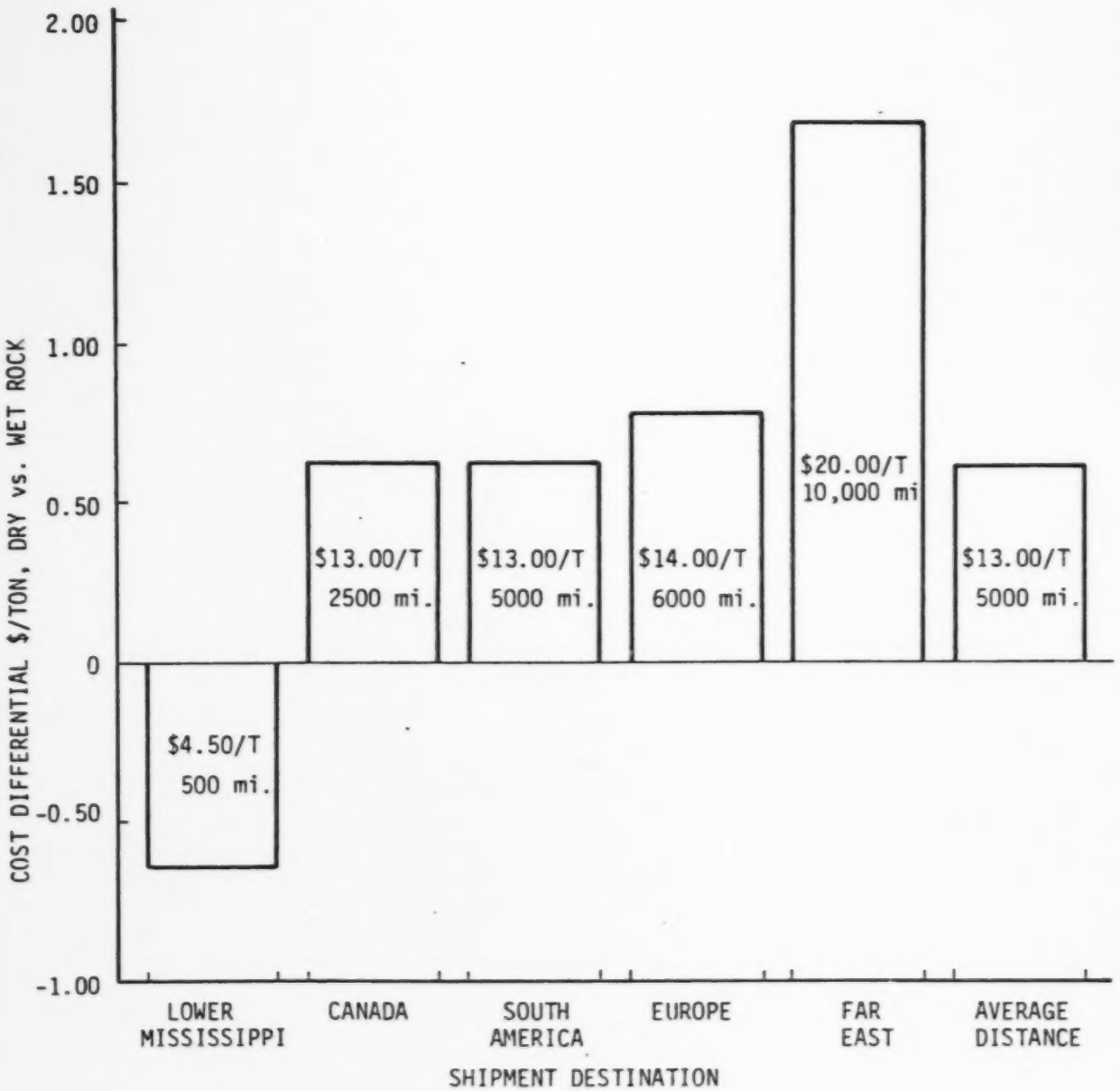
the cost of the product; therefore, contract drying at an existing site or construction of a new dryer at an alternate site are expensive alternatives. Drying at a port facility could be a viable alternative since the product would of necessity require some handling and possibly storage which would normally be a part of the mine's dryer facilities. These costs would then be transferred from mine to port site. Cost savings in fuel for drying are also a possibility at a port location. There are no existing public port facilities, however, that offer these advantages to Swift.

In terms of operating costs at the mine plant site, shipping wet rock is less expensive than drying the rock. These costs, however, are only transferred and increased if the customer is not capable of processing the wet rock since water must be shipped and then removed by drying. As shown in Figure 12-1, the heavier rock results in higher delivered costs at all points of delivery except the lower Mississippi.

Total acceptance of wet rock, as the basic form of the phosphate rock commodity on the world market, is not expected for some time due to the following problems:

- Many users have small phosphoric acid plants and the designs vary widely making conversion to wet rock not only expensive but technically difficult.
- Conversion to wet rock requires installation of wet rock grinding in addition to major wet phosphoric acid process design changes.
- Small dryers located at small plants are inefficient and very expensive compared to the large units employed by rock producers.
- Capital for the modifications is not readily available in many developing countries.
- Some dry rock is used to produce triple superphosphate for which no wet rock process exists.
- Beyond the 1,000 mile radius, shipping costs exceed drying costs; therefore, the competitive marketing cost becomes a major factor. Product grade, quality, and condition become more important in the world market and customer specifications will remain an important consideration.

More energy in the form of fuel oil is consumed to dry the rock than is consumed to ship the additional water in the wet rock, assuming that the rock will not be dried at the final destination. Figure 12-2 shows how energy consumption to ship the moisture in the rock increases with shipping distance and how it compares with the energy consumption



Basis: $1.75/Ton to dry rock at the plant site.

Note: Ocean freight rates and mileages are for typical phosphate shipments from the port of Tampa.

Figure 12-1 C & F PORT OF ENTRY COST DIFFERENTIAL DRY VS. WET ROCK

Zellars-Williams, Inc.

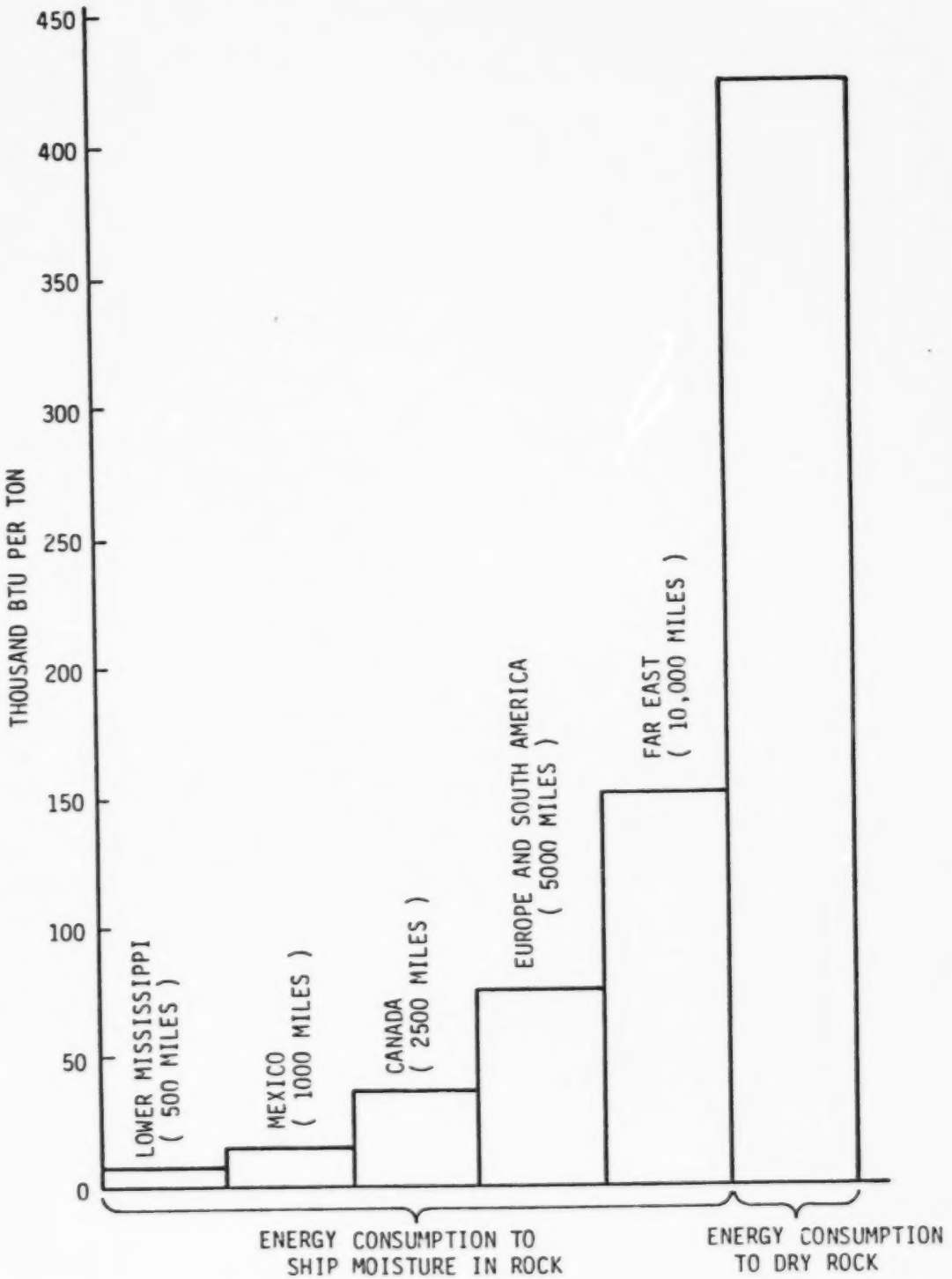


FIGURE 12-2 Energy Consumption.

Zellars-Williams, Inc.

to dry the rock. For the case of rock dried at the final destination, energy consumption would be the greatest since the energy consumed in shipping the water would be added to the energy consumed in drying the rock.

Environmental Aspects - From an environmental viewpoint a ranking of alternatives from best to worst may be characterized and summarized as follows:

Ship Wet Rock - This is the best environmental choice only if the rock is not dried in less effectively controlled equipment at the destination. From a standpoint of phosphate rock customer requirements, it is, in effect, also a no-project alternative. Within the range of available and viable environmental alternatives, the present preemptive nature of this alternative suggests that it possibly not be included as a real environmental alternative. With a gradual shift to wet rock grinding and processing facilities, shipment of wet rock may eventually be demonstrated as reasonably practical and a preferred environmental alternative.

New Dryer at Remote Site - In all probability, the remote site would be located within a port facility in order to avoid costs of double handling and reshipment by rail. Available port locations vary in degree of industrial development, but all are marginal with respect to one or more air quality standards. In such instances, present source emission standards may be insufficient to insure conformance with ambient standards, and more sophisticated, state-of-the-art control equipment, would be required. The result would be a reduced contribution to the regional pollutant burden, and most probably offer a better or best environmental choice. For example, the best site might be within an area designated for non attainment, because the new source would have to negotiate at least a corresponding reduction (offset) from another source so that there would be a projected reduction in overall area emissions. This extreme example should indicate potential economic unattractiveness of locating the dryer facility at a port facility.

Dryer at Duette Mine (Proposed Action) - It is required that this new facility be designed, constructed and operated in accordance with the existing body of environmental legislation and regulations that were developed to protect the public health and welfare. It must be recognized that the environmental analyses suggest these requirements can be satisfied, and some cases, with considerable margin. Thus, the alternative must be considered a basically acceptable action from an environmental viewpoint.

Use Existing Dryer at Remote Location - Continued or expanded use of older, less effectively controlled equipment would contribute increased quantities of pollutants in the region.

As existing facilities are typically located in areas marginal with respect to air quality standards, this alternative might even subject localized segments of the public to adverse health and/or welfare conditions until the problem was detected, documented, and corrected by regulatory agencies. In some cases, this process could involve considerable time.

Both wet and dry phosphate rock are minor gamma radiation sources, and there is no measurable difference in radiation levels between the two products. Lung dosages of radiation are higher near dry rock facilities, but conventional dust control systems maintain radiation levels within the guideline for occupational exposures. The application of best available control technology for new source dryers would be expected to reduce pollutant concentration levels even further. Workers near adequately ventilated wet and dry rock processing facilities are generally are not exposed to radiation levels exceeding guidelines for the general population (telecom-Dr. E. Bolch, December 6, 1978).

Pollutant Control System Selection: Prevention of Significant Deterioration (PSD) regulations include a requirement for application of Best Available Control Technology (BACT) to major source developments. BACT is a formalized analysis of potentially applicable control systems and a final selection based on performance (i.e., pollutant removal efficiency), economics (i.e., capital and operating costs), and irretrievable energy requirements. The process is completed following regulatory approval of the control concept and issuance of a BACT Determination.

A preliminary evaluation of pollution control systems narrowed the evaluation to two practical alternatives for both the dryers and fugitive dust control systems---fabric filtration (baghouses) and wet scrubbing technologies. A summary of the advantages and disadvantages of fabric filtration and the proposed wet scrubbing technology are developed from BACT analysis applications (BACT, 1979) as follows:

Fabric Filtration Technology

- o Advantages
  - a) High particulate matter collection efficiency
  - b) No process water requirement (unless collected particulate matter is transported to disposal by the environmentally favored means of slurry pumping systems).
- o Disadvantages
  - a) Solid waste must be disposed rather long distances by truck via unpaved haul roads which

would introduce vehicular pollutants and fugitive dust emissions.

b) Fabric Filter systems remove only particulate matter and do not have inherent removal capabilities for gaseous pollutants, e.g., sulfur dioxide, nitrgen oxides, gaseous fluorides, etc.

c) System capital cost is definitely greatest when fabric filter is paired with a pollutant gas absorption system to remove sulfur dioxide. Cost is similar without a gaseous pollutant removal system.

d) Moist, corrosive gases will rapidly deteriorate all but the most expensive bag fabric material, i.e., teflon.

e) Fabric filtration technology has been tried, but not successfully demonstrated on phosphate rock drying facilities. Capability has been demonstrated on predominantly gas fired, small capacity units in other industries.

f) Filter bags may become plugged (blinded) by fuel oil soot before the otherwise useful service life is achieved. This permanent filter bag destruction may introduce excessive maintenance cost for bag replacement and installation.

g) The warm dryer and fugitive control system exit gases contain considerable moisture and would require either electric or fuel oil inlet gas preheaters to prevent condensation and accompanying catastrophic blinding of filter bags with mud. Electric heating is extremely unfavorable from a cost and energy use standpoint. Heating with fuel oil compounds the problem discussed in item g above.

h) Additional energy required for inlet gas preheating.

i) Correspondingly increased pollutant emissions, i.e., sulfur dioxide, nitrogen oxides, carbon monoxide, etc. are contributed by combustion of additional fuel oil.

j) Air compressor required for bag cleaning system requires additional electrical energy.

k) Operating delays for system startup and shut-down.

l) Minimum/maximum temperature control system required to prevent condesation formation and/or melting bag fabric, respectively.

Wet Scrubbing Technology (Proposed Venturi-Absorbers and Wet Centripetal Vortex Contact Scrubbers)

o Advantages

a) Comparable high collection efficiency for

particulate matter.

b) High inherent collection efficiency for sulfur dioxide (further enhanced by reagent addition system).
c) Some anticipated removal of nitrogen oxides.
d) Some anticipated removal of trace gaseous fluorides.
e) Lowest overall energy use.
f) Lowest operating cost.
g) Anticipated lowest maintenance cost.
h) Maximum operating convenience.
i) Lowest capital cost on dryers (possibly similar cost for fugitive dust applications).

o Disadvantages

a) Increased system pressure drop, i.e., fan horsepower, requirement to achieve desired removal efficiency and a corresponding increase in electrical energy use.
b) Liquid handling system pump horsepower required with corresponding increased electrical energy need (compared with a fabric filter not provided with gaseous pollutant removal system).

13. PRODUCT TRANSPORTATION ALTERNATIVES

13.1 Background

The transportation objective is to ship the phosphate rock to local or port destination as efficiently and safely as possible with minimum disruption. The following alternatives have been selected for assessment.

Railroad with Truck as Emergency Mode - The proposed action by the applicant is to ship all the phosphate rock produced at this plant via railroad to port facilities in the Hillsborough or Manatee County area, or to local destinations in Central Florida. In the event of an acute rail car shortage, prolonged strike, or other such difficulty that would prevent the use of rail for shipment, provisions could be made for shipping the product by truck.

Trucks Only - All product would be transported by truck from the plant site to the destinations above.

Pipeline to Port - This alternative would consist of pumping the rock in slurry form through a pipeline from the plant to port facilities, which is the intended destination for a large increment of the production.

Conveyor Belt - The product would be loaded on a conveyor belt at the plant and transported by the belt system to the port facilities.

13.2 Product Transportation Assessments

Railroad with Trucks as Emergency Mode - Swift intends to use an average of about 100 rail cars (80 tons capacity each) daily for the shipment of phosphate rock. Rail shipment is by far the most commonly used method by the Florida phosphate producers. Trucks are used occasionally to ship rock, such as during a rail car shortage or a general railroad strike. Disadvantages to the option are the cost of rail service construction, the need for a continuous zone of right of way and/or purchased land, occasional unavailability of rail cars due to shortages or other operational difficulties, and dependency on a single supplier for service. Notwithstanding the capital investment by either the railroad or the company, such rail service is of reasonably competitive cost compared to other transportation mediums, estimated to be about $1.90 per ton of product shipped.

Trucks Only - The use of trucks to ship all of the phosphate rock would involve approximately 320 trucks (50,000 pounds of material per truck) per day. Working three shifts, it would entail loading and moving one truck every 4.5 minutes. Truck traffic could use a road system which would make minimal use of major arterial highways, except for small portions of the system. This would probably not add significantly to the existing traffic load. Presently neither a route has been established nor has the capacity of a road system to withstand such traffic been defined. Full impact of truck transportation cannot, therefore, be evaluated properly at this time. There may be problems with congestion and exhaust emissions. Also, traffic dust in off-the-road transportation would exceed that of rail. The estimated shipping cost is $0.12 per ton mile, and the distance from the mine site to Port Manatee is about 27 miles; therefore, the approximate cost is $3.24 per ton of product.

Pipeline - In order to construct a pipeline from the plant to port, a continuous zone of right of way and/or purchased land must be acquired. Also, there would be a major problem in water quantity and quality control. Water loss would be great if it could not be returned to the mine (at further pumping expense). Saline water could not be used to make up water used in pumping the slurry, because of water quality; i.e., pumping high chloride water into the interior regional drainage system. The operating cost to pump this product is estimated to be about $1.89 per ton.

Conveyor Belt - The use of a conveyor belt would involve much the same problems as use of a pipeline in terms of initial cost and maintenance. Operating costs would be lower, costing an estimated $0.68 to ship one ton of rock. The conveyor would need to be covered or enclosed to protect the phosphate rock from wind and rain and possibly to reduce

dust emissions. The conveyor is used reliably in other parts of the world for long distance transport, but the initial capital cost is prohibitive for its use in this instance, due to the high cost of a right of way and the installed cost of the conveyor.

13.3 Selection of Optimum Alternative

The optimum alternatives for transportation of the phosphate rock to the port facilities in the Tampa Bay area are that of railroads and/or trucks. Railroads are established in Central Florida and they are reliable. The initial capital cost of installing the railroad would be weighed versus operational cost. Consideration should be made in sharing rail services with other phosphate users in the area. Presently, rail is the most economical transportation available because it uses less energy and is generally environmentally acceptable. Long trains can disrupt traffic at various intersections with major arteries. The truck alternative will use more energy, but it is a lower capital investment and, in some cases, has a higher reliability. However, it has environmental (air pollution) considerations, it would contribute to traffic congestion, and it is not known if the present road systems have the ability or capacity to handle the traffic.

14. ENERGY SOURCE ALTERNATIVES

14.1 Background

The objective is to maintain maximum efficiency in energy conservation while minimizing energy costs and environmental disruption or impact. The following energy source alternatives have been selected for assessment.

Commercially Available Electric Power - Swift proposes to obtain electrical power from Florida Power and Light's proposed 230 KV transmission line that will run along the south and west border of the mine property. Projected daily consumption of electrical power is 52,000 KVA average and 61,000 KVA at maximum, or peak load.

On-site Generation by Coal, Oil Gas - This alternative would require the construction of a small, conventionally-fueled generating plant on Swift property, which is technically feasible.

On-site Nuclear Power Generator - This alternative would require the construction of a small nuclear power generator plant on Swift property, which is technically feasible.

On-site Solar Power Generator - This alternative would require the use of solar collectors to utilize the sun's radiation for electricity. A battery bank, or some other

means of storing electricity, would also be required. While this is theoretically possible, it is not technically feasible at this time.

On-site Hydroelectric Generators - This alternative would require installing hydroelectric generators in a dam built across one or more of the streams on the property. As in solar energy use this is theoretically applicable, but it is not a viable alternative.

14.2 Energy Source Assessments

Commercially Available Electric Power - The proposed action to buy power from Florida Power and Light will require the construction of conventional transmission towers and lines from FP&L's main 230 KV transmission line and substation to the beneficiation plant, a distance of about 2.25 miles. The substation would be required in order to step the power down from the regional transmission lines. Florida phosphate companies presently use the commercially available electric power rather than other means of energy. Environmental impacts of this construction would be very small, requiring minor tree clearing for right of way and tower building; most of the corridor would remain essentailly undisturbed. FP&L would provide a line to the beneficiation plant. Using the average power consumption estimate presented in the DRI, using an overall plant utilization of 75 percent and considering the current electrical rate of $0.031 KWH, the estimated cost of buying electrical power is about $9 million annuallly or $3.00 per ton of phosphate rock product.

The cost for power in the phosphate industry is low because industrial demand is at a constant rather than a peak loading rate. It is more efficient for the power companies who have to design their facilities to meet peak, rather than average, loads. Phosphate companies are also on an interruptable basis; i.e., when total peak demand surpasses the capacity of the system the phosphate operations are shut down. These two factors lend the rate to be very reasonable.

On-site Generation by Coal, Oil, Gas - A conventionally powered generation plant would have three costly drawbacks or constraints, even though it is technically feasible. First, the capital cost would be close to that of building the plant site itself; and the cost of operating the plant (personnel and fuel cost) would probably equal or exceed that of the cost of purchasing the power. Second, valuable mineral resources could be lost to the on-site energy plant; i.e., building and cooling pond area could not be mined for phosphate. Third, special measures would have to be taken to insure a non-polluting energy system. Additional air pollution abatement systems would have to be installed for the generation to handle high sulfur oil or coal.

Power sharing would require construction of an on-site

electrical generating plant which would be connected to FP&L's transmission grid, but which would still be a major capital investment. Advantages to power sharing would include selling to FP&L the excess energy produced by the on-site plant. Conversely, if power requirements periodically exceeded onsite generating capabilities, power could be bought from FP&L. Power sharing could also include the possibility of jointly owned and operated plants among the phosphate producers and suppliers. The feasibility of such an "energy cooperative" is not known.

On-site Nuclear Generator - With the exception of a reduction in air pollution, this alternative has the same drawbacks as generation by coal, oil, or gas. In addition, strict control of the fuel and security for fuel waste disposal would have to be resolved at considerable expense to Swift. At the current rate of permitting and construction, this type of facility could not be operational until after mining progresses.

On-site Solar Powered Generator - Current technology has not advanced to the point where sufficient electrical energy could be obtained from the sun to satisfy mine requirements on a practical, non-interruptable economic basis.

On-site Hydroelectric Generators - This is a proven effective, nonpolluting, and generally low cost form of energy production. None of the streams on the property, however, are capable of suppling the needed steady water flow to provide the mine's electrical requirements, since during the dry winter period these streams stop or nearly stop flowing. If a dam were constructed to provide a reservoir, the construction would not only inundate valuable phosphate but also would probably have to extend off Swift's property, incapacitating useful agricultural land. It is not known at this time if hydroelectric generators could supply sufficient power to supply the plant. This is a thoughtful alternative in terms of energy conservation, but unproven as to technical or economic feasibility. Disruption to the regional drainage system would be significant.

14.3 Selection of Optimum Alternative

The only feasible alternative is to purchase the required power from a commercial producer. This source is practically cost-free to the miner to build and maintain and is environmentally acceptable. Once mining operations are complete, an on-site power facility has unknown usefulness.

15. NO-ACTION ALTERNATIVE

15.1 Background

The no-action alternative would be to not construct the proposed New Source on the Duette tract and to allow the area to continue its present day socioeconomic and environmental trends. Summarized below are general local and regional effects related to continuance of the present day socioeconomic and environmental trends with reference made to the potential influence of the proposed Swift activity on these trends.

15.2 Effects of No-Action

Socioeconomic - The general socioeconomic effects of the no-action alternative on the region and local area can be derived from baseline descriptions and projections of demography, economics, and community services. These baseline elements indicate that failure to construct and operate the proposed new source would exert little effect, positively or negatively, on general regional or local projections for population growth, economic growth, or demands for community services and facilities.

The region, and Manatee County specifically, has a considerable immigration of new residents and an expanding and diversifying employment base. These trends could be expected to largely mask any effects exhibited by the no-action alternative on regional or local demography or employment. The region and Manatee County would be expected to continue its general trend of population growth and employment diversification as a result of its favored "Sunbelt" location. With regard to community services and facilities, demands would be expected to increase unaffected by the status of the Swift proposal. These demands would be created through general population growth pressures. In any case, phosphate mines are generally isolated and, by necessity, are largely self-sufficient in fire and police protection, water supply, etc.

The general result of the no-action alternative on socioeconomic conditions of the region and specifically Manatee County would, in effect, be one of unrealized potential economic benefits. Economic benefits of the proposed mine, as represented in the DRI Application by Swift would be about $4.5 million in local property and state severance taxes with no appreciable effects exerted on public services, facilities, etc. Additionally, the projected $25 million annual expenditures by Swift for products and services would not be realized.

The no-action alternative would, of course, represent the loss of 61.5 million tons of phosphate rock resource. The annual production rate of 3 million tons of rock is about

8 percent of current Florida phosphate production.

On a greater than local or regional scale, a potential for positive impact on the United States' balance of payments would be lost due to unrealized sale of the rock product, upgraded rock products and food products grown domestically.

Environment - The present day general trend for eastern, rural Manatee County to be largely devoted to agricultural activities is not expected to change in the foreseeable future. The only noticeable change to this trend, which is viewed as temporary in nature, is the approval of two phosphate mines in eastern Manatee County as Existing Sources. The two approved mines, neither of which are presently in operation, are located immediately north and south of the Swift Duette tract.

In the absence of mining on the Duette tract, it is expected that little physical modification of the tract will occur over the next two decades. Because of the relatively poor soil conditions at the Duette tract, it is unlikely that the native rangeland (cut-over flatwoods), which comprise the majority of the site, would be rapidly converted to improved agricultural uses. The practice of clearing native rangeland for production of watermelon and/or tomato crops for a few seasons may result in several hundred acres eventually converted to improved pasture. This conversion of a few hundred acres of the tract to pasture should not exert significant adverse impacts on the biology and ecology of the site. As current land clearing practices for improved agricultural use usually avoid wet soils due to the impractically of its use as pasture or for row crops, significant destruction of wetlands on the tract is not expected.

If additional acreage is cleared for row crops and/or improved pasture as assumed, irrigation requirements would probably result in average annual withdrawals of groundwater approaching that proposed for the mining. These withdrawals would be confined to the dry season only, however, and probably would result in worst case aquifer drawdowns exceeding those associated with mining on the tract.

In the no-action alternative, therefore, most if not all unavoidable adverse environmental impacts, associated with mining would not occur. The existing natural setting would continue more or less unchanged. A projected benefit associated with mining and reclamation, the improvement of soil quality and productivity potential, would also not accrue.

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